THE SYNECOLOGY OF THE GOLD COAST

AND

THE SILVICULTURE OF SOME GOLD COAST TREES.

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I. HISTORY.

In order to understand the ecology of a country, it is as well to know something of its history. There is little doubt that some of the vegetation has been changed and that change is taking place now. Much of this has been a retrogressive change and has been brought about by man through wars, hunting, farming or in search for and exploiting mineral wealth. A country's communications have a bearing on its development, and development in this Modern Age usually results in the destruction of some of the natural vegetation. It is therefore considered appropriate to include this chapter in an ecological work.

The early history of the Gold Coast is very obscure, and nothing definite is known until towards the end of the 15th century. This was when the first authenticated contact by Europeans was made with the Gold Coast. Even for some time after this, records refer to only the immediate vicinity of the trading posts set up along the coast. Little or nothing was known of the hinterland until near the end of the 17th century.

There seems little doubt that the dense tropical high forest was at the most only sparsely inhabited before the people living in the more open forest to the north were driven into it by waves of invaders from further north. Present day nationalists would have the Gold Coast called Ghana. They believe Ghana to have been the centre of an old civilisation near Egypt from whence they originated. There appears to be no historical evidence of the present day Gold Coast tribes having come from such a place or having had a civilisation associated with the Egyptians.

It is probable that at times during the 11th and 12th centuries, invasions by the powerful Moshis were made into what is now the Northern Territories. These invasions began the series of drives which caused the southern peoples to take refuge in the dense tropical forest where horsemen could not penetrate. The splitting up into tribes would take place then. Perhaps the dangers and difficulties of travel in the forest kept these tribes more or less apart for considerable periods. Dialects came into being, but all these belong to the Akan language. The principal exceptions are the Ewe, Adangbe, Krobo and Ga tribes in the south-east who are likely to have come from the east. It is almost certain that the Gas came by sea and that they were not an inland immigration.

Perhaps the Phoenicians traded with the Gold Coast in

Classical Times, and the finding of "Aggrey beads" in the immediate hinterland to the coast has been offered as evidence. Similar beads have been found in North Africa and in India, where the Phoenicians are known to have traded. However, the first documentary evidence of trading is in 1471, when the Portuguese reached the Gold Coast. They set up a settlement at Elmina, which owes its name to Oro de la Mina, for it was near there that gold was obtained. It was not so very long afterwards that the Slave Trade had its beginnings. The first slaves were taken to Portugal. It was later that the Slave Trade was extended to the West Indies and North America.

The British, French, Dutch, Brandenburghers, Danes and Swedes took part in the Slave Trade, and set up various trading posts along the coast. Some of these remain to this day as castles and forts in varying degrees of preservation. Eventually, in 1871, the Dutch ceded their castles to the British, and so ended the trading rivalries between the European nations on the Gold Coast.

Near the end of the 17th century, the great Osei Tutu founded Kumasi, and this marks the beginning of the Ashanti Kingdom. For the next 170 years, or so, the Ashantis were forever warring against their neighbours. They subjugated the Dagombas in the North, and held many of the forest tribes tributary. This was brought to a head when they crossed the River Pra on their way southwards. A British expedition was despatched to Cape Coast. It invaded Ashanti and entered Kumasi on 4th February 1874. It was not till the turn of the century that peaceful conditions obtained in Ashanti.

The infamous African Slave Raiders, Samory and Babatu, caused a tremendous amount of destruction to lives and property in the Northern Territories at the end of the 19th century. Evidence of their devastations exists to this day, especially those caused by Samory in the Gonja District.

The Gold Coast, as we now know it, comprises the Colony, Ashanti and the Northern Territories. Under British rule, the Colony has known different constitutions, having at different times been associated with Sierra Leone and Lagos. It is a colony by settlement. Ashanti was annexed as a colony by conquest in 1901, and at the same time the Northern Territories was declared a Protectorate. After the first World War, part of the former German colony of Togo came under

the administration of the Gold Coast as a British Mandated Territory. It was re-designated Togoland under United Kingdom Trusteeship in December 1946.

TRADE.

The first trade appears to have been for gold. It was recorded that 150 pounds of gold were sent to England in 1553. Near Elmina the Portuguese mined gold in a small way, and a casual trade was carried on by Africans using primitive methods for extracting the gold. It was not till 1877-78, when Jules Bonnat, a Frenchman, took out concessions near Prestea and Tarkwa, that a serious attempt was made by Europeans to mine gold. Since then, several mines and alluvial workings have been developed. Some have gone out of production. The 20th century discoveries of bauxite, diamonds and manganese have been important to the economy of the country.

It was not long before slaves became more important than gold. Most of them were destined for the plantations in the West Indies and North America. This iniquitous trade continued until Britain abolished slavery in 1807.

One of the greatest events in the history of the Gold Coast was the introduction of the cocoa plant. In 1815 the Dutch recorded having brought plants from Surinam. This venture came to nothing. Some 50 years later, at the Basel Mission Station at Akropong, two cocoa trees bore fruit. Although the new crop attracted much attention, it was not until 1879, when one Tetteh Quarshie returned from a visit to Fernando Po, that its popularity spread. He had seen the intensive cultivation of cocoa on the island and had brought some of the seedlings to the Gold Coast. These he planted near Akwapim Mampong. He may be said to have founded the cocoa industry of the Gold Coast.

The Akan peoples obtained their food from the forest, and this consisted of some meat, but mostly of leaves, berries and a few tubers such as "wild" yams (Dioscorea spp). When the Portuguese began trading for slaves, they were faced with the problem of feeding those awaiting transportation overseas. As a result, most of the present day foods of the Gold Coast people owe their introduction to the Portuguese. These are mainly American and Asiatic in origin - viz: cassava, groundnuts, plantains, yams, coco-yams, sweet potatoes, maize, bananas, citrus, pawpaw and pineapple.

There were attempts at growing coffee and cotton and

there is a record of P. Thonning, the Danish botanist, being sent out to the Gold Coast to report on its agricultural possibilities. He visited the experimental plantations at Aburi, Akropong and Dodowah, where it seems, the coffee was doing well. In 1850 an attempt was made to grow cotton near Cape Coast. These early coffee and cotton plantations were abandoned because of wars and the difficulty of getting labour.

In 1820, the palm oil industry began in a small way, but soon increased in importance. In more recent times it has declined considerably.

Trade in cola nuts has been mainly a domestic one. Although a crop of the High Forest Zone, the seeds are most popular with the peoples of the Savannah-Woodland. A large trade takes place from the south to the north, and some of the nuts go across the frontier into French Territory.

Small samples of timber were exported in 1888-90, but the timber trade had its real beginning in 1891, when 112,000 cubic feet of mahogany (Khaya and Entandrophragma) were exported. In 1913, a peak of 3,115,988 cubic feet was reached, and then the exports fell away until 1918, when there was a rise to 1,223,402 cubic feet. In these early years, almost all the timber was obtained from the south-west of the country. Use was made of the rivers Ankobra and Tano and the railway line running up-country from Sekondi. In recent years exports in million cubic feet of logs and sawn timber have been as follows:

1936	1948	1949	1950	1951
0.921	7.070	7.517	9.162	9.788

With the opening of the Accra-Kumasi and Huni Valley - Kade railway lines, more of the High Forest Zone became accessible. Nowadays almost all the export timber trade passes through Takoradi. Before this harbour was opened in 1928, most of the logs had been exported from Sekondi, Axim and Half Assini. A notable feature of the post Second World War period has been the erection of sawmills, and the export of sawn lumber. Logs and sawn lumber to the value of £4,911,671 were exported in 1951.

COMMUNICATIONS.

The Sekondi-Kumasi railway line was opened in 1903, and the one from Accra to Kumasi, although begun in 1909, was not completed till 1923. There are branch lines to Kade, Prestea and Awaso and a link was made with Takoradi on the opening of that port. At the present time (1952), the Gold

Coast Railway operates passenger and goods services on 536 miles of line.

The more developed parts of the country are reasonably well supplied with roads. Altogether, there are some 9,000 miles of roads. Some of these are not usable by cars during the rains.

POPULATION.

The greater part of the population is engaged in agriculture and allied pursuits. The 1948 census gave the population of the Gold Coast and Togoland under the United Kingdom Trusteeship as 4,118,450, of which 4,111,680 were Africans and 6,770 non-Africans. The density averaged 44.8 per square mile, but it varied in Districts from 5.8 in Gonja (Northern Territories) to 286.8 in Akwapim - New Juaben (Eastern Province of the Colony). An exception in the sparsely populated Northern Territories is the Zuarungu area with a density of over 200 persons to the square mile.

ACTIVITIES OF THE FORESTRY DEPARTMENT.

Because of the growing interest in timber, H.N.Thompson, Conservator of Forests, Southern Nigeria, was invited to visit the Gold Coast and make a report. In the first six months of 1908, he made a comprehensive tour of the High Forest Zone and also saw parts of the southern Savannah-Woodland when he visited Bamboi and the Afram Plains. In his Report (43) he suggested the enactment of Forest Legislation, the Protection of Timber Trees, and the introduction of Property Marks for fellers. Amongst other suggestions he made were the formation of a Forestry Department, Forest Reservation, the collection of Working Plan data, the botanical survey of the forests, the training of subordinate staff, the formation of plantations, the supervision of Timber Concessions, and that a Forest Policy be introduced.

A small Forestry Department, with N.C. McLeod from Nigeria, as Conservator, came into being in September, 1909. It continued until 1915, when its officers went off to the war, but it was resuscitated in 1919 by McLeod.

In 1907, a Timber Protection Ordinance was enacted to protect certain immature trees against felling. Under the Timber Protection Rules, Property Marks were introduced in 1921. The Forest Bill was first submitted in October 1910, but there was strong objection to it because it was alleged that it interfered with the rights of the natives over the

land. It was not till 1927 that a Forests Ordinance became law. This delayed the work of Forest Reservation, except where Chiefs were willing to create Forest Reserves under Bye-Laws.

In its earliest years, the Forestry Department was mainly concerned with the timber industry. The next phase was the creation of Forest Reserves. The collection of botanical data took place concurrently with this. Most of this was done by T. F. Chipp in the early years, and then by Chidlow Vigne.

The taungya system of regeneration was introduced in 1929, and 1% enumeration surveys were begun in 1931.

At the present time (1952) Forest Reservation may be said to have almost reached completion in the High Forest Zone with 19% under Forest Reserves (some 5,780 square miles). Attention is being paid to putting Reserves under Working Plans, and to Silvicultural Research, with particular emphasis on natural regeneration.

The approved Forest Policy includes:-

(a) The creation of a permanent forest estate by reservation, in order to provide the people and the country with the direct and indirect benefits of forests.
(b) The proper management of the forest estate.
(c) The conduct of scientific forestry research.
(d) The education of the people to a better understanding of the necessity for, and the value of, their forests.
(e) The control of the utilisation of the forests outside the permanent forest estate, to make its supplies last as long as is reasonable.
(f) The training of African staff.
(g) The provision of technical advice and assistance to non-Governmental Forestry.
(h) Co-operation in schemes for the prevention of soil erosion, and in land usage plans.

II. T O P O G R A P H Y.

The Gold Coast, including Togoland under United Kingdom Trusteeship, is situated in West Africa between approximately 4°45'N. and 11°10'N., and 1°12'E. and 3°15'W. Its southern boundary is the Gulf of Guinea, with a coast line of some 334 miles. The northern boundary is about 380 miles distant. The landward frontiers are with French Colonial Territory.

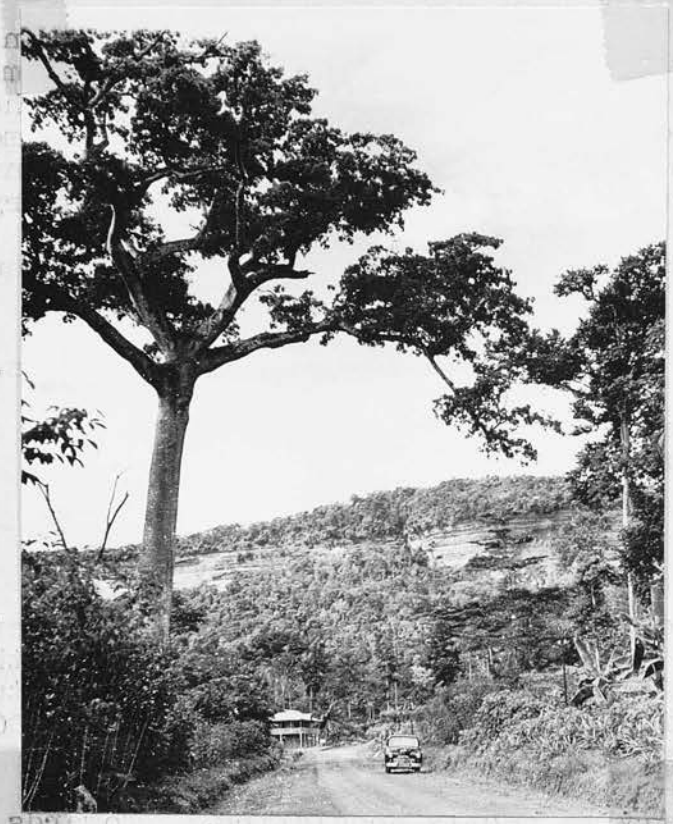
The Gold Coast has an approximate area of 91,843 square miles, made up as follows (48):-

Colony	23,937	square	miles.
Ashanti	24,379	"	"
Northern Territories	30,486	"	"
Togoland under United Kingdom Trusteeship	13,041	"	"
	91,843	"	"

About one-third of the country is less than 500 feet in altitude, and half is between 500 and 1,000 feet. Of the remaining one-sixth of the area, the greater part is between 1,000 feet and 2,000 feet in altitude. Nowhere is 3,000 feet exceeded.

Much of the country is gently undulating. Towards the south-west, the topography is characterised by many small but steep hills, often more or less surrounded by freshwater swamps. Such swamps are not confined to the south-west of the country. In fact, they are quite common, although often obscured in the High Forest Zone. However, they are evident because of the specialised vegetation they bear. Except for individual hills, the southern part of the Colony is below 500 feet in elevation. That part of the plain to the east of Sekondi is particularly important because of the effect that climatic factors have had on it. This is discussed in Chapter III. The other large area of fairly flat country includes the Afram Plains and the greater part of the Volta basin.

In general, the high land above 1,000 feet in elevation falls into four main geographical groups. The most extensive group begins at Koforidua and stretches in a north-westerly direction. For some 125 miles from its southern end, it takes the form of an escarpment, although interrupted here and there. The scarp faces are to the south. Beginning from the Koforidua end these are known as the Kwahu, Mampong and Ejura and Kintampo



Kwahu Scarp.

Scarps. The greatest altitude on the Scarps is 2,500 feet at Tutuogirim, in Kwahu. Going westwards, the high land widens in extent, but the characteristic features of the Scarps are absent. The highest hill is Kwamisa, 2,516 feet. This group of escarpments and high land forms a natural division of the country into northern and southern parts.

From some 12 miles north of Accra a range of hills runs in a north eastern direction into British Togoland and continues into French Togoland, where it reaches its greatest heights. This high land starts with the Akwapim Range. In British Togoland it widens considerably and much of it is over 1,000 feet in height. The greatest altitude is Torogbani, 2,900 feet, near the French frontier.

In the north-east of the Northern Territories is the Gambaga Scarp, extending for some 40 miles in an east-west direction. It goes up to 1,350 feet, and has its principal scarp faces to the north.

The fourth zone of high land is in the north-west of the Northern Territories. Most of the principal features are between 1,000 and 1,100 feet, and the highest is 1,212 feet, on the northern border. A prominent range runs northwards from Bole. Another mass of high land extends some 30 miles in a Southerly direction from near Tumu.

Other prominent features rising above 1,000 feet, although relatively small in area, are the Atewa Range (2,420 feet), near Kibi, Bosumtwi Range (2,321 feet) running south from Lake Bosumtwi, and various hills in Sefwi.

As might be expected in a country with a southern seaboard, the rivers flow in a general southerly direction. South of the Kwahu-Mampong Scarp, the principal rivers are the Tano, the Ankobra and the Pra. The last few miles of the Tano are through the Ivory Coast. The remaining two-thirds of the country is drained by the River Volta and its tributaries. The Volta, which rises in French Territory, flows into the sea through a delta at Ada, in the south-east. None of the rivers mentioned is really navigable for anything much bigger than launches and lighters, and even then, for no great distances. Rocks, rapids and the relatively shallow depth of water are the obstacles. Another drawback is the presence of sandbars at the mouths. However, if the Volta River Scheme for hydro-electric power materialises, the lower stretches of the Volta will be made more navigable than at

present. It is proposed to build a dam at Ajena, some 60 miles up-river from Ada. This will cause flooding of the Volta and its tributaries for some miles north of Ajena and the creation of an artificial lake in part of the Afram Plains.

The coast line is low-lying. It is only slightly indented and is relatively straight, diverging in two directions (N.W. and N.E.) from Cape Three Points, which is the most southerly extremity of the Gold Coast. The ocean bed slopes away very steeply to a Great Deep, some 16,000 - 20,000 feet in depth, running parallel to the coast between Cape Palmas (Liberia) and Accra.

Lagoons are found along the sea coast at various places. They contain salt water, brackish or fresh water. Except for the Keta Lagoon, they are small individually. Usually the strip of sand separating the lagoon from the sea is quite narrow, being but a few yards wide. From time to time it may be breached, either by the sea or by inland water. In some parts very near to the coast, as between Elmina and Cape Coast, low lying areas may be seen. These are apparently relics of old lagoons. Often they are separated from the sea by a low ridge, more or less parallel with the coast line. Another example of this seral stage is near Esiama.

The only real lake is Bosumtwi, which is said to be a sunken explosive caldera (48). The lake is roughly circular in shape, with a diameter of about 4 miles. In 1934, the greatest recorded depth was 238 feet. Because of the dead trees standing in the lake some little distance from the present shore line, it is obvious that the water level has risen in recent times. The lake is surrounded by steep sided hills, rising to 1,000 feet and more above sea level.

III. C L I M A T O L O G Y.

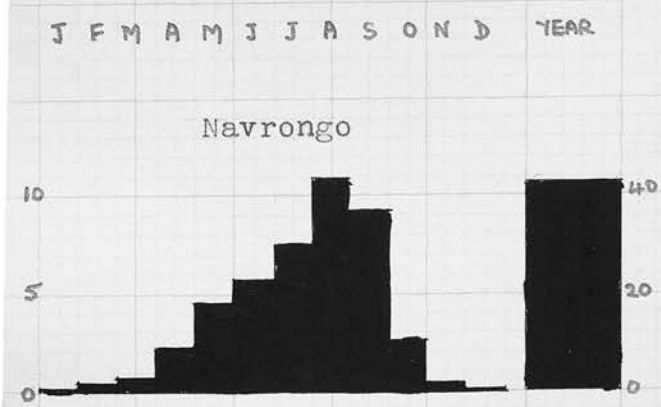
The natural vegetation of the Gold Coast is closely connected with the climate. Except where it has been upset by man, the vegetation may be described as a Climatic Climax.

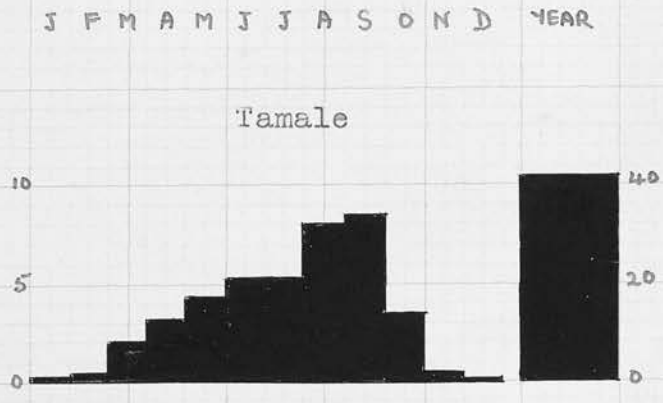
In general terms, the country has a tropical climate. Low temperatures, frost and snow are unknown. The shade minimum and maximum temperatures range from about 65°F. to 100°F. According to the climatic classification for West Africa (11) the southern half of the Gold Coast lies within the Guinea Climate and the northern half in the Sudanese Climate. The main distinction between these two climatic types is the one annual rainy season and pronounced dry season in the latter, and the two rainy seasons a year in the former. Although this classification holds good for the Gold Coast, it is easier to consider the climate as a monsoon one, as the seasonal changes are directly concerned with the South-West Monsoon.

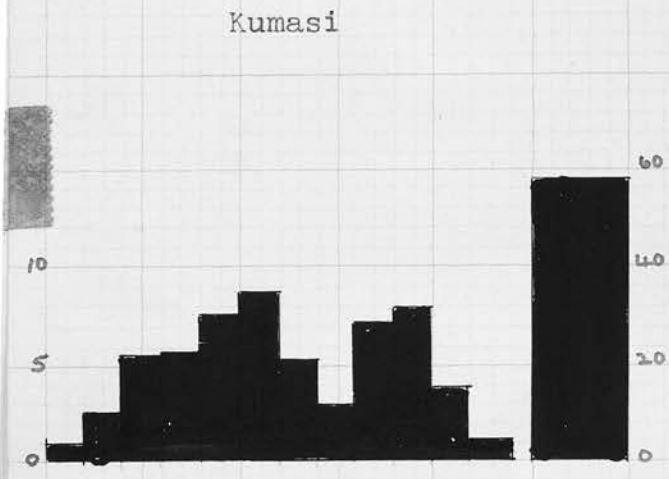
The South-West Monsoon is a moisture laden wind originating in the South Atlantic. By the time it reaches West Africa, it has travelled over a great expanse of water. In the Gulf of Guinea and for some distance inland, the South-West Monsoon blows for most of the year. From the north-east, blows the harmattan. A large part of its track lies over the Sahara and so comes from desert conditions. The harmattan is a deep current blowing along the surface in the north, but further south it is above the South-West Monsoon. Where the South-West Monsoon and the harmattan are in juxtaposition is known as the Inter-Tropical Convergence Zone. The Inter-Tropical Convergence Zone oscillates irregularly from North to South, but with two main passages shortly after the summer solstice (21st June) and the winter solstice (22nd December). It reaches its furthest north in August and furthest south in January. With its southern advance it brings dry conditions and a general reduction of visibility. The harmattan haze is due to transported dust from the arid desert regions of the north. It may give the sun the same red appearance as in fog. In its southern limits it does not blow continuously over the land - the prevailing wind is from the South-west, and the harmattan makes incursions into it.

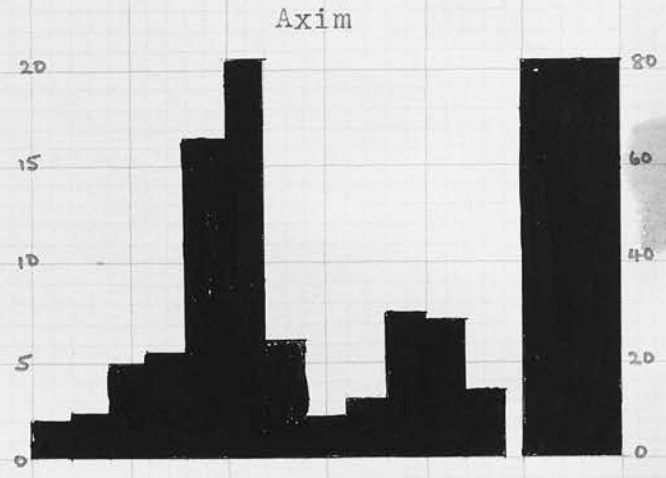
The effect of the harmattan is felt most in the Northern Territories, where from November to March, climatic conditions

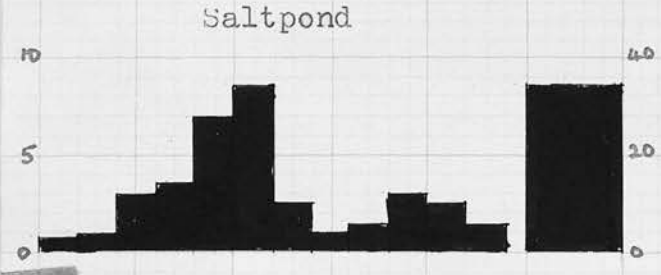
Rainfall in Inches.

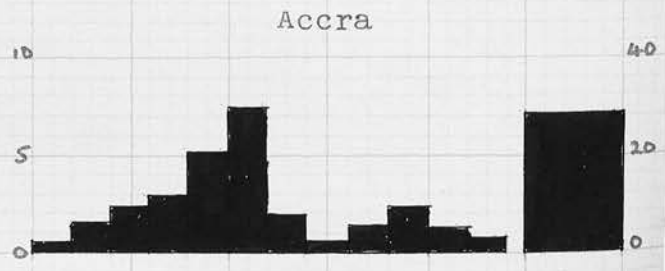












can be quite severe. The dry air causes the human skin to feel parched. The days are hot and the nights and early mornings are cool. Although it is a time of flowering and fruiting for many plants, there is little vegetative growth except under the stimulus of fire. The ground is hard and dry. This is the danger period when the grass, which comprises the bulk of the ground flora, is dead, dry and inflammable. It is easily set alight. These grass fires have done and are doing untold damage to the vegetation, not only in the Savannah-Woodland Zone where they originate, but also in the Transition belt between it and the High Forest proper.

The moist atmospheric conditions caused by the trees in transpiration lessen the severity of the harmattan in the High Forest Zone. In Kumasi, it is neither great nor prolonged, and is felt most in early January. The south-west corner, protected by a great depth of forest, is little affected.

The seasonal rain is brought by the South-West Monsoon. In general, the isohyets decrease in value from the south-west to the north-east. An exception is the dry littoral beginning near Sekondi and widening towards the east. This coincides with a line of coast running more or less in the same direction as the monsoon. A study of the rainfall charts for the West Coast of Africa reveals the fact that where the coast line is at right angles to the path of the South-West Monsoon, the rainfall is greatest. Thus the coast line running north-west from Cape Three Points to the Ivory Coast gets a far greater rainfall than the coast line running to the north-east. This incidence of the coast line to the South-West Monsoon is of far greater importance to the precipitation than land elevation. Whereas the mean annual rainfall of Axim is 83 inches and Accra 29 inches - both coastal towns - that of Aburi, some 19 miles from Accra and 1,500 feet above sea level, is only 45 inches.

Walker and Swan (44) have sub-divided the country into the following rainfall types:

(i) One rainy season rising from March to a peak in August or September and then decreasing quickly. This type occurs north and east of a line running through Wa and Salaga.

(ii) A single rainy season between March and October, with not much variation between the monthly totals. This area is bounded on the north by type (i) and on the south by a line running through Kintampo and Hohoe.

(iii) Two rainy seasons with peaks in May-June and October. December to February and July, August and early

September are drier. This area is bounded on the North by type (ii) and on the south by a line through Wiawso and Keta.

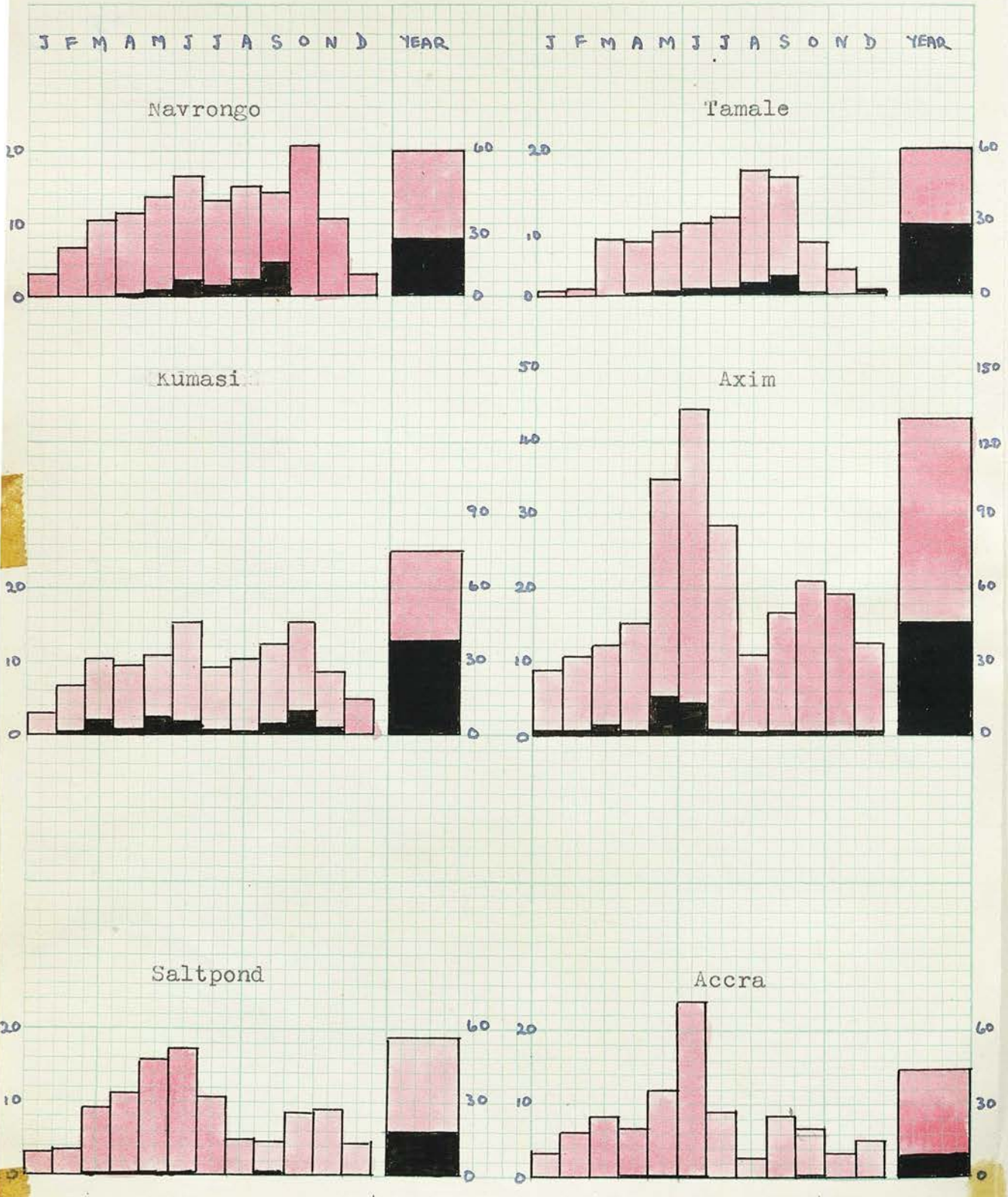
(iv) Two rainy seasons with the principal peak in May-June and the subsidiary in October. This type occupies the area to the south of type (iii). The authors state that there is evidence for two subdivisions of this type, for in the west the principal maximum (associated with the greatest rainfall in the Colony) is particularly well marked, and in the east (associated with the lowest rainfalls) the subsidiary peak is scarcely in evidence.

In the Zones of the one annual rainy season, i.e. Northern Ashanti, Northern Togoland and the Northern Territories, the average precipitation for the year is a little over 40 inches. December to February are dry months, with very little rainfall or none. May to September are the months of heavy rains, reaching a maximum of about 10 inches in August.

That part of the two rainy seasons area occupied by the High Forest Zone may be conveniently divided into two parts - (a) the wet south-west corner and (b) the remainder of the Zone. In the south-west the average annual rainfall is about 85 inches, but 130 inches have been recorded in Axim, with 17 inches falling in a day. No month is without rain, although December and January may have only about 2 inches each.

In the remainder of the High Forest Zone the average annual rainfall is about 60 inches, but local variations occur because of the topography. On the Kwahu-Ashanti Mampong Scarp it is about 10 inches greater. This is due to the effect of hill masses forcing the moisture laden winds into a higher and cooler atmosphere. A striking difference is seen in the Afram Plains to the immediate north of this high land. There the rainfall is obviously less, although there are no climatological records to support this statement. It sometimes happens that the second peak (September-October) is greater than the first (May-June). December and January are the driest months, with less than 2 inches each and January may be completely dry. Flooding of rivers often happens in October-November. By this time the land has been thoroughly soaked and so a larger proportion of the rain water finds its way into the streams and rivers. Except in June, when rain does occur during the early morning, most of the rain falls from about 1600 hours onwards. Indeed, it has been calculated (47) that Kumasi has roughly one-third

Rainfall Extremes in Inches.



of its "rain-hours" between 1830 - 2130.hours.

Except on the higher land, the rainfall in the Coastal Belt east of Sekondi averages 30 inches - 40 inches a year. May and June are the wettest months with about 6 inches and 8 inches each at Accra. The second peak in October is a very minor one with only about 3 inches. In August, September and December to February, the monthly average is 2 inches or less. January may be entirely dry in some years. Unlike the forest country, much of the rain in Accra falls between 0800 - 1000 hours. Least falls between 2000 - 0400 hours (47).

Falls of rain may be very localised. It is not uncommon for rain to fall in one part of a town such as Kumasi, while another sector remains dry. The variations between two stations in Kumasi, some 3 miles apart is shown by the following recordings:

Rainfall in inches.

Year	Airport	Cadbury Hall	Difference inches
1948	52.51	43.42	9.09
1949	65.28	73.01	7.73
1950	48.75	46.58	2.17
1951	60.04	70.58	10.54

The annual variation of rainfall may be considerable. Such extremes are shown by the following figures:

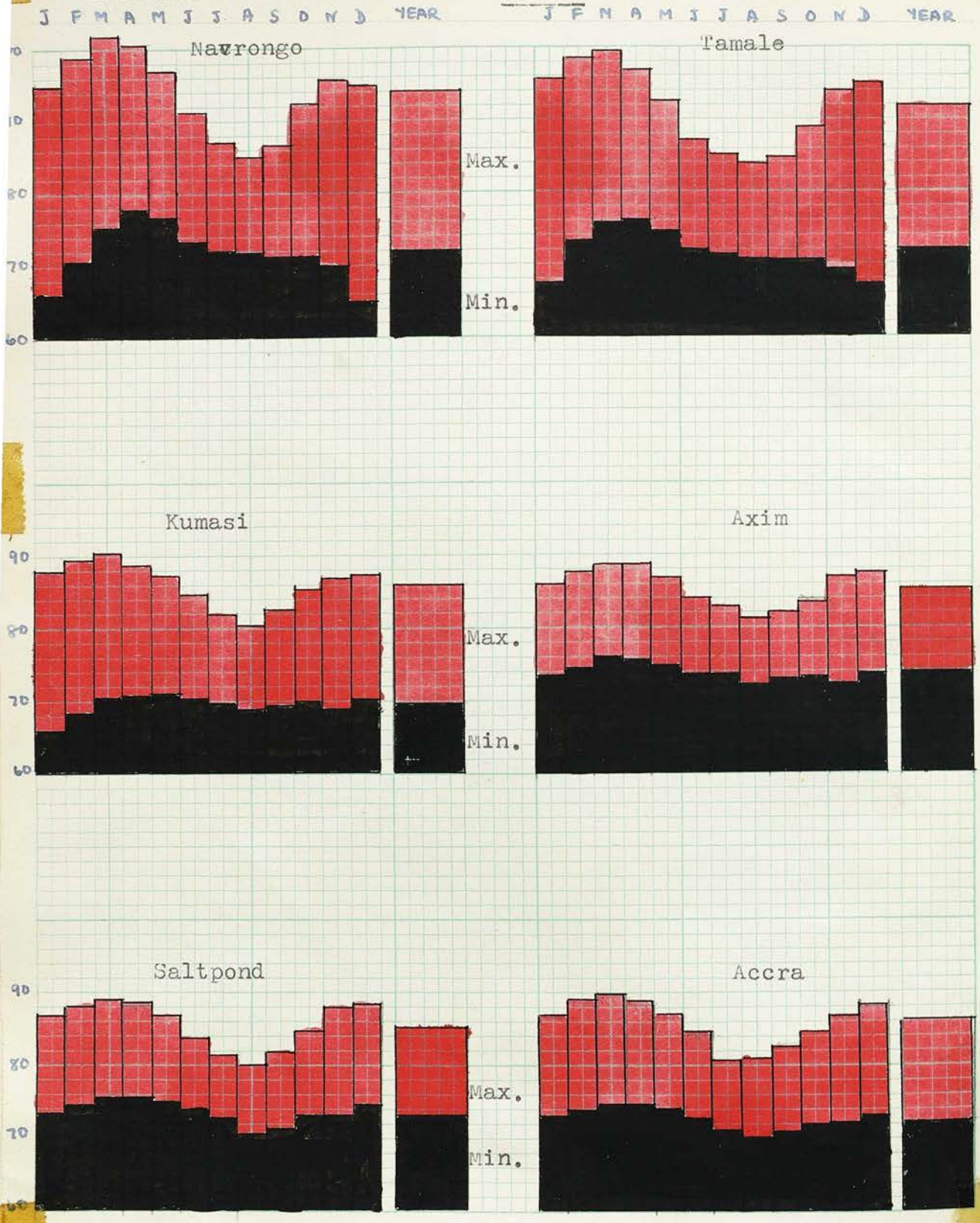
Annual Rainfall in inches.

Station	Maximum	Minimum	Difference
Navrongo	60.85	25.47	35.38
Tamale	61.69	32.27	29.42
Kumasi	75.33	40.07	35.26
Axim	130.39	47.64	82.75
Accra	44.26	10.84	33.42

There is also a monthly variation of considerable amounts. These are shown diagrammatically.

Similarly, the beginning and end of the rainy season is variable.

Maximum & Minimum Temperatures in Degrees Fahrenheit.



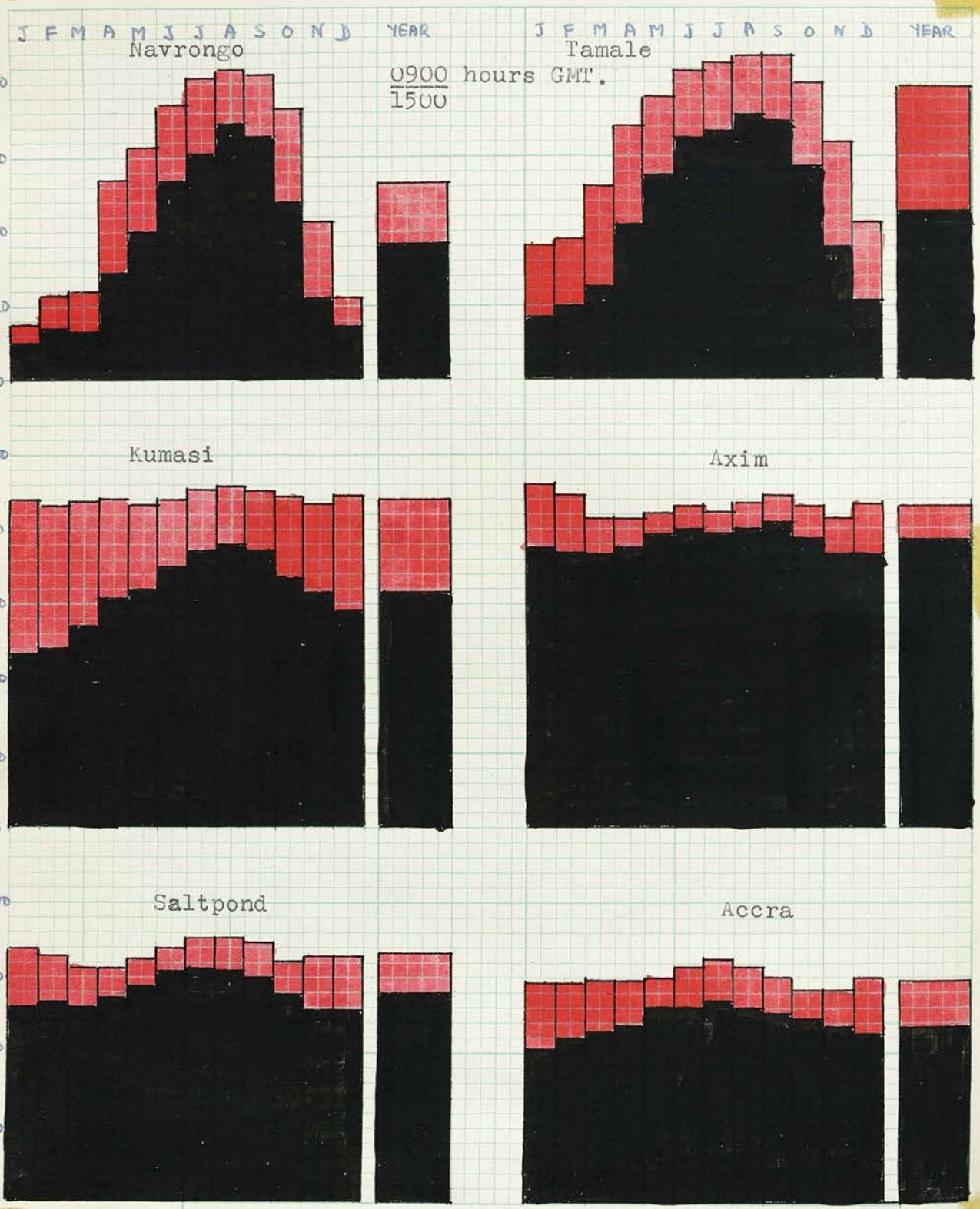
Wind speeds are, in general, low. They average under 5 miles per hour inland and 5 - 10 miles per hour on the coast. Even on the coast the sea breezes seldom surpass 20 miles per hour. These are localised, but their effect is felt at Benso, some 23 miles inland from Sekondi, and probably further. The sea breezes have a diurnal variation and their greatest speeds are attained during the afternoons. The variation is due to the fact that the land mass heats up during the day more so than the sea and the air over the land ascends and so a current of air moves from the sea to the land. It drops quite suddenly with nightfall, when the land cools and the daytime sea breeze becomes a night-time land breeze. Thus the nights on the coastal strip are noticeably warmer than those inland.

Line squalls, locally miscalled tornadoes (44) are usual at the beginning and end of the dry season. So, their greatest frequency is in March and November. They are accompanied by thunder, lightning and rain. These squalls come from the north-east to east - i.e. the direction of the harmattan - and happen quite suddenly. The first warning of the approach of one is the building up of the towering shapes of cumulonimbus clouds in the east. Shortly afterwards thunder and lightning become apparent and then the sky darkens in the east. As soon as this dark mass of clouds is overhead, a sudden and strong squall blows from the north-east. It is followed some minutes later by a few drops of rain and then by torrential rain. The duration of the storm is usually short. The rain may stop almost as suddenly as it began. This is quite normal with the storms early in the year and those late in the year, but with the others, steady rain may last for an hour or two afterwards. These squalls are more usual just before sunset or with nightfall. The average strength of the wind is reckoned to be about 25 miles per hour. One effect they have is to blow over some trees - usually exposed ones in farms and on roadsides. Another is to cause a temporary lowering of the temperature.

In the southern half of the country temperatures are equable. The range of average shade maximum temperatures for the year is 80°F to 90°F. The shade minimum is from 65°F. to 75°F. The hottest period is in March, just before the rainy season begins; the coolest is in August. The highest temperatures occur between about noon and 1400 hours and the lowest in the very early hours of the morning - just before sunrise.

In the Northern Territories, temperatures are influenced

Relative Humidity %



to a large extent by the harmattan. The hottest day period is from February to April when the mean maximum temperature is about 100°F. The minimum shade temperature reaches its lowest in January with about 68°F. Thus the harmattan brings about temperature extremes of hot days and cool nights. As is to be expected, the lowest minimum temperatures occur during the rainy season.

In the High Forest the Relative Humidity is high throughout the year. The 0900 hours G.M.T. readings are seldom below 85%; where the station is actually in a forest environment it is about 95%. There is greater variation with the 1500 hours G.M.T. readings where the influence of the harmattan is felt.. In Kumasi, the minimum is in January, with about 47%. This increases until August-September when it falls away again. On the otherhand, there is little departure from the 75% - 80% at Axim in the afternoons, for the influence of the harmattan is very slight in the southwest corner of the country.

The greatest variations in Relative Humidity are found in the Northern Territories. The lowest 0900 hours G.M.T. recordings for Navrongo are in January with 15%; this increases to 84% in August and then falls away. The corresponding figures for 1500 hours G.M.T. are 10% in January and 69% in August.

Dew is common in the High Forest Zone even during periods of quite severe harmattan. It also occurs in the Northern Territories and is especially noticeable in river valleys during the harmattan.

Hail is a rare occurrence. Sometimes it comes with the March and November storms.

IV. S O I L S.

The soils in the Gold Coast depend on a combination of climate, lithology and topography.

The dominating climatic factors are the rainfall and the length of the dry season. In the High Forest Zone, where there is plentiful rainfall and a short, not severe dry season, thorough leaching takes place. But in the Savannah-Woodland, especially in the far north where there is a smaller rainfall, but more important still a pronounced long dry season of up to 5 months, there is a tendency for bases to accumulate in the lower part of the profile.

The geology of the country (Appendix 3) may be divided for convenience by the High Forest and Savannah-Woodland junction line. In most of the area to the north are the Voltaian sedimentary rocks, with granites to the north-west and extreme north. There are local occurrences of greenstone - e.g. near Zuarungu. In the High Forest Zone are granites, Akwapimian sandstones, greenstones of the Upper Birrimian Series, Lower Birrimian phyllites, schists and Voltaian sandstones.

The topography is generally undulating, with some marked escarpments, but of no great height (Chapter II).

A soil catena is a series of soil types linked in their occurrence and repeated in the same relationship to each other over a broad lithological group. This concept is applicable to Gold Coast soils. The typical catena may be divided into (a) summits (b) slopes (c) bottoms. In the High Forest the summits tend to have a red soil, below which, and perhaps at no great depth, ironstone concretions are often to be found. These concretions may exist as pisolites or they may be cemented together into a hardpan. On badly eroded areas they may be exposed on the surface. The red hues are due to the oxides of iron being dehydrated on the top of the catena. The slopes, especially the middle slopes, contain a well drained soil of varying degrees of yellowish hues. The colours are dependent on the state of the hydration of the iron oxides - the more hydrated, the lighter the colour. Fertile soils are quite usual on these middle slopes. The soil of the valley bottoms is typically grey; the absence of red and yellow hues is due to the iron oxides being in the ferrous state. These soils may be either sandy or clayey.

The development of such a catena is due not only to drainage conditions but also to the eluviation of the finer particles by surface run-off and the movement of the surface soil mass by soil creep.

The physical condition of this catena is good on the summits providing there is not too much gravel or pan. It is usually good on the middle slopes, where the gravel and pan content is less and at a greater depth. Many of the valley bottoms are composed of grey sands and their physical condition is dependent on the drainage. They may be waterlogged or flooded during the rainy seasons but may dry out completely during periods of no rain (10). In a narrow valley the soil is colluvial, but alluvial in a broad valley.

In the Savannah-Woodland, the soil catena differs from the typical High Forest one just described in being subjected to drier soil conditions alternating with a wet period. First the upper layers dry out and then the middle slopes. The valleys may show the two extremes of being waterlogged or of drying out completely.

The High Forest soils derived from granites consist of an upper sandy layer not usually greater than one foot deep and below it a sandy clay. The proportion of sand and clay depends on the parent rock. The granites in the Northern Territories are similar but the soils are shallower.

The Lower Birrimian catena is not unlike that of the granites but the soil is finer grained.

The Akwapimian sandstones give coarse grained, freely draining soils.

From the greenstones of the Upper Birrimian series are derived well drained, friable, orange or reddish brown clays (34). In general, valley bottoms should be avoided when siting a nursery, because of the rather infertile sandy soil and its liability to extreme water conditions. However, on an Upper Birrimian catena it is reasonably safe to have a nursery almost anywhere because both drainage and nutrients are present. But these greenstone soils are said to be particularly low in available phosphate (34).

Sandstones and shales are the predominant members of the sedimentary rocks of the Voltaian Series. The summits and upper slopes of the sandstones tend to have reddish hues and the soils are sands or clayey sands and usually with good drainage. The middle slopes have yellowish-brown hues. The valleys may be poor in nutrients. The soils on a shale catena are clayey and shallow on the summits and middle slopes. The lower slopes and valley bottoms are often waterlogged during the rainy season and may dry out during the dry season. These soils are highly leached and of poor quality. Examples of these shales

occur in parts of the Afram Plains. They bear a poor and specialised vegetation.

The soil under High Forest cover owes much of its fertility to the top layer of humus. The litter which accumulates on the forest floor is decomposed by fungi and micro-fauna (termites principally) to give humus. The hot, moist environment provides ideal conditions for this decomposition. Generally there is little undecayed litter, although the fallen boles of large trees may take a few years to disintegrate thoroughly. Gradually the humus is washed into the top layers of the soil where it imparts a dark brown colour. Once the forest cover is removed and the soil exposed, the humus layer may be lost to a considerable extent by oxidation at high temperatures and by wash.

Terminalia superba.

VI. L I F E F O R M S.

Many and varied are the plants which comprise the natural vegetation of the Gold Coast. Predominant amongst them is the tree, which finds its development in the High Forest Zone. There it reaches heights of up to 200 feet, and a bole girth of 20 feet or more. This tropical high forest is storeyed. The trees belonging to the upper and emergent canopies have typically clean straight stems, and in some cases, their crowns are very small, e.g. Celtis soyauxii. Such a feature, as shown by this species, is not found just where the tree crops happens to be a dense one, but is a genetical character and is borne also by C. soyauxii trees growing in isolated positions. Many of the trees belonging to the lower storey, i.e. those not attaining a height of more than about 60 feet, are low branched and heavy crowned.

The trees of the Savannah-Woodland are characteristically short boled and with low crowns. They are found in an area often subjected to grass fires, and so thick, corky barks are not uncommon. Exceptions are to be found in riverain forest, where the trees may attain a greater height and have straighter boles. In such localities, they are less liable to fire hazards.

The rooting system of the High Forest trees is typically a shallow one, and is confined to lateral roots. Although a tap root is usually developed in the seedling, it is no longer evident once the tree reaches the pole stage. Many of the bigger trees develop buttresses. These are due to an inherent genetical character, and the type produced is true of the species. They appear to be a peculiarity of trees in a tropical climate with an abundant rainfall. Locality factors do not seem to influence the development of buttresses, except the age when they are formed, and in causing a greater development in one particular direction to answer a physical condition. The formation of buttresses is not usually apparent until the tree gets older, but they show their appearance at an early age in Piptadenia africana. Buttresses may be thick, or they may be the so-called plank buttresses of trees like Terminalia superba, where they are very narrow. Buttresses may not spread far from the bole (Celtis soyauxii), or they may travel 20 feet or more from the tree (Piptadenia africana). In Triplochiton scleroxylon they may reach 15 feet or more up the bole, whereas in Tetrapleura tetraptera, they seldom are higher than a foot or two above ground. Tarrietia utilis shows a strange formation, for as the buttresses develop, so

Daniellia similis.

Piptadenia africana showing greater development of buttresses on the upper slope.

does the central rooting system disappear. At first sight the phenomenon appears like some lifting process. The result is similar to deep and narrow stilt roots. This condition is hastened where the soil conditions are wetter. Thompson (43) observed of these buttresses of T. utilis "--- in this respect represent an intermediate stage between the cylindrical aerial 'prop-roots' and the typical plank buttresses".

No true buttresses appear in Chlorophora excelsa, but in the older trees there are usually what are termed "root spurs". They are really thickenings of the lateral roots, and they run up the stem for a short distance. Some of the larger roots of this tree are usually partly visible for they are close to the surface and may be exposed in places. Entandrophragma angolense not only forms buttresses, but also develops large thick surface roots. A tall tree, conspicuous because of its very straight cylindrical stem and its lack of buttresses is Baniellia similis.

Although the term "buttress" is in general use, it would appear to be an incorrect general description of the development or modification of the root. Observations show that the function of these buttresses is usually a pull against the stem and crown, and therefore they function not as buttresses but as guys or stays. A leaning tree has its greatest development of buttresses on the side away from the direction of the slant. Similarly, a tree growing on a hillside has larger buttresses on the upper side of the slope. In such cases, it is obvious that they are subjected to a tension and not a compression force.

Buttresses are absent from Savannah-Woodland trees. Where soil conditions permit there is a tendency for a deeper rooting system to be developed than in the High Forest.

Stilt roots are usually associated with trees whose natural habitat is very wet soil conditions, e.g. Rhizophara racemosa, Uapaca heudelotii and Xylopia staudtii. An exception is Musanga cecropioides. which never grows in wet situations. Its stilt roots may be delayed in development if the trees are growing close together. It is interesting to note that Uapaca guineense growing in the High Forest develops stilt roots. This species is also found in the Revived Savannah-Woodland to the immediate north of the High Forest Zone. There it does not form stilt roots, although one example has been seen near Kintampo, where a bole had been injured, and there was an attempt at developing a stilt root.

Bosquiea angolensis.

Pneumatophores, being an adaptation to stagnant or brackish conditions where the water is insufficiently aerated, are to be seen in Raphia vinifera, Avicennia nitida and Taguncularia racemosa.

There are comparatively few trees whose stems are armed with prickles, spines or thorns. Examples are Ceiba pentandra and Fagara macrophylla. When the tree gets older, the spines may be confined to the branches, and the bole is free of them, as in Cylicodiscus gabunensis. Such outgrowths are rarer in the Savannah-Woodland, but they are to be seen on the branches of Erythrina senegalensis, Balanites aegyptiaca and Ximenia americana.

Fluting of the bole as a genetical character is to be seen in Balanites wilsoniana and Bosquiea angolensis, both medium sized trees and in Trichilia heudelotii, and understorey tree. Triplochiton scleroxylon when grown under conditions not suited to it, may develop a badly fluted stem.

Evergreen and deciduous trees occur both in the High Forest and in the Savannah-Woodland. The proportion of evergreen trees increases with the greater rainfall. This phenological character is true of the species, but may be modified slightly by environment. Cistanthera papaverifera on its northern limits in the transition belt between the High Forest and the Savannah-Woodland, may be deciduous for a brief period. The duration of diciduousness of a species is likely to be shortened when telluric water is available. It is usually during the dry season that the deciduous trees lose their leaves, but the phenomenon appears to be linked in some definite way with the sexual condition of the individual tree as well. Ceiba pentandra is a deciduous tree of the emergent canopy in the High Forest. At varying times between October and March, individuals lose all their leaves. Those which are not going to flower and fruit, break into new leaf after only a short bare period, whereas in flowering and fruiting specimens, the new leaves are not produced until after fruiting, or at any rate, until the fruits have been formed. C. pentandra may show the two conditions on the same tree, of one part of the crown bursting into new leaf but without flowers, and the other part without leaves but producing flowers.

Terminalia superba is leafless in the dry season and the mature fruits are dispersed during this period. A different condition exists in Mansonia altissima and T. ivorensis which normally retain their leaves and fruits until towards the end of the dry season. Individuals of Entandrophragma angolense fruiting in August, shed all their leaves as the capsules open. New leaves are produced in November - before the advent of the dry season.

Most deciduous species of the High Forest do not begin to shed their leaves annually until they have reached a sexually mature age - at any rate until they are capable of producing flowers. This also applies to individuals growing in open conditions, and therefore shows that this is not due to the microclimate of the understorey of the High Forest influencing the younger trees of deciduous species to keep their leaves on during the dry season. An exception is Chlorophora excelsa.

For most tree species, seeding is an annual event. Combretodendron africanum produces flowers and fruits twice a year. Fruiting may be prolific, as in Mansonia altissima. The other extreme is seen in Distemonanthus benthamianus, for very few trees of this species fruit in the one year, and they produce very little seed. Triplochiton scleroxylon is unusual in that it has periodic flowering. Flowering years are irregular, and there are insufficient data to correlate this to any particular factor.

Soil and atmospheric conditions in the Savannah-Woodland during the protracted dry period are more severe than in the High Forest. This is due to the desiccating effect of the harmattan. The evergreen state is less common, but it is shown by such trees as Parkia filicoidea and Tamarindus indica. The riparian Celtis integrifolia and Khaya senegalensis are also evergreen. A tree worthy of note is Acacia albida. It possesses the peculiar character of being in full leaf during the dry season and deciduous during the rains.

In the High Forest, the periods of flowering and fruiting vary with the species. Flowering in Terminalia superba begins in February. This is rather early. Mansonia altissima and Sterculia rhinopetala begin in July. Many flower near the beginning or during the early part of the dry season. The major fruiting period is towards the end of the dry season. Although fruits of Mansonia and Terminalia ivorensis may be found on the forest floor in August, they are immature. Many of the High Forest species have small flowers and rely on wind for pollination. Showy flowers are found in the Bignoniaceae, Bombacaceae and Papilionaceae, and in some members of the Caesalpinaceae.

The main flowering period in the Savannah-Woodland is during the dry season. Seeds are produced from April onwards, which is timely for the beginning of the rains.

Fruit and seed dispersal is mostly by animals (including birds) and wind. In the High Forest, wind dispersal is not very efficacious as there are many tree obstacles in the way. So, winged seeds and fruits are not scattered very far from the parent trees. On the other hand, seeds with a pappus, such as Funtumia elastica, which are very light and are capable of taking advantage of upward currents

of air, may be scattered quite a long way. Birds are very effective in distributing small seed long distances, e.g. Chlorophora excelsa. Berries and drupes are often eaten on the parent tree and so the seeds are dropped nearby.

The viability of the seed of High Forest species is notoriously short in many cases, e.g. Entandrophragma cylindricum and Turraeanthus africana. This is not to be wondered at, for growing conditions in the High Forest Zone are so good because of the heat and dampness, that no resting period is required. Similarly in the Savannah-Woodland, for although conditions are not as good as in the High Forest, most of the seeds are produced at a favourable season for germination and growth. Exceptions are found in some of the Acacia species, which have hard seed coats and are capable of remaining dormant for some time.

Capsular fruit may be affected by the state of the weather in the High Forest Zone. If the September to November rainy season is protracted into what is normally the dry period, then woody, capsular fruits, such as those of Entandrophragma and Khaya, may fall without opening. Not only is seed dispersal very much reduced, but the capsules tend to fall immature. In this state they are very liable to insect attacks on the forest floor. A normal dry season helps seed formation and dispersal.

The autumnal shades of red and brown which are so characteristic of many deciduous trees of temperate lands, are absent from the tropical high forest deciduous trees. If a change in leaf colour does take place on the tree, it is quite sudden and is yellowish. The leaf in this state does not remain on the tree for long. An exception to this generalisation is Combretodendron africanum. Its leaves turn red just before falling, even although the tree is not deciduous. On the other hand, flushing of new leaves in evergreen and deciduous trees is often accompanied by a red or bronze coloration. Distemonanthus and Parkia bicolor produce bronze coloured new leaves. Those of Cynometra ananta present a colourful picture twice a year - in April-May and August-September. Two small trees with bright red flushes are Carapa procera and Spondianthus preussii. They are usually found in damp situations. It is interesting to note that red flushing is quite common in trees associated with damp soil conditions.

Tree leaves assume various shapes and sizes. Growing together in the Rain Forest are Lophira procera, with its strap-like, simple leaves up to 36 inches long and 4 inches broad, and Piptadenia africana, which has bipinnate leaves, with leaflets only 0.2 inches long. However, trees with very large simple leaves are not common. Specialisation is to be seen in the thickened leaves of the mangroves- Avicennia nitida, Laguncularia racemosa and Rhizophora racemosa.

Strangler (Ficus sp.) on Alstonia boonei.

Climatic conditions in the Savannah-Woodland are not sufficiently severe to cause a general reduction in leaf size. The Acacias occur in this zone and they do have reduced leaves. Their climax zone is beyond the northern boundary of the Gold Coast.

Cauliflory is to be seen in a few trees in the High Forest, such as Cola acuminata, C. chlamydantha, Napoleona parviflora, Omphalocarpum ahia and Treculia africana. It is an uncommon condition and does not seem to be related to any particular site factors. Cauliflory is not found in trees with thick barks because of the difficulty the flower buds would have in breaking through. So it is rarely seen in the Savannah-Woodland. Exceptions are thin barked species of Ficus, which also occur in the High Forest.

Development of epicormic branches on High Forest trees is rare. When a tree happens to be isolated, as in some farm clearing, it continues to keep its clean bole, and seldom do branches form below the existing crown. This ability to grow straight, unbranched stems, is characteristic of most of the High Forest trees. When grown in the open, a light demander, such as Terminalia ivorensis, will clean itself of its lower branches. On the other hand, Cylicodiscus gabunensis, under similar conditions, will retain a fairly deep crown, but the stem will grow straight, and heavy branches will only develop at the top when the bole has attained its maximum height.

Epiphytes are a characteristic of the moist, tropical forest. These true epiphytes are to be found in the crowns of the tallest trees. They are mostly orchids and ferns, such as Bulbophyllum spp. and Platycerum spp. In the northern parts of the High Forest, these epiphytes may be fully exposed to the harmattan and are therefore subjected to xerophytic conditions. Some species of Ficus, such as F. leprieuri, begin their lives as epiphytes. Later they send roots down, and as soon as they become established in the ground, the plant takes the form of a strangler, wrapping itself round its original host, and taking its place as a tree with a hollow centre where the dead host has rotted away.

Most of the trees of the High Forest and Savannah-Woodland are capable of producing coppice shoots. But this faculty is lost by many when they become old - particularly those of the High Forest. So, it is rare to find coppice shoots arising from the stumps of the large trees felled by timber merchants. It should be noted that the leaves of coppice shoots may be considerably bigger than the normal ones.

Because of what are really ideal conditions of heat and dampness, the High Forest tree has not been obliged to adopt forms of vegetative propagation. A different state of affairs exists in the fire swept Savannah-Woodland, where any part of the tree above ground may be burnt. This burning occurs during the dry season, which coincides with the flowering and fruiting periods

Young Terminalia ivorensis showing self-cleaning of lower branches.

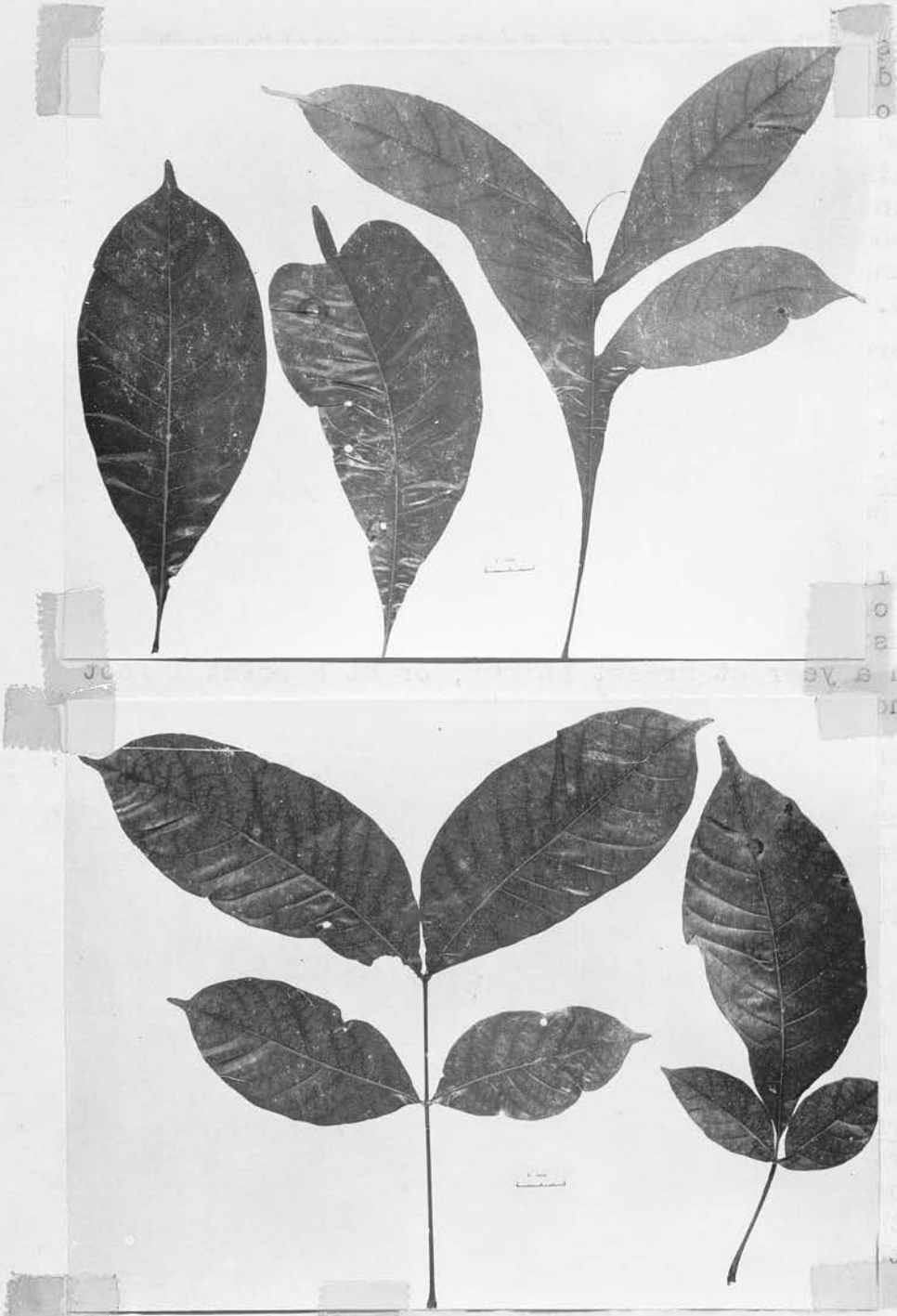
of most of the trees. The flowers and fruits are particularly vulnerable to fire damage; the boles of the larger trees are less vulnerable because of their thick barks; but the roots are least likely to be damaged. From them, new shoots may be sent up at the beginning of the rains. These root suckers are commonly produced from the lateral roots of Isoberlinia doka. This vegetative propagation is secondary to the production of seed, and no case is known of a Savannah-Woodland tree having lost its powers of sexual reproduction.

In the High Forest the desire of the tree species belonging to the upper and emergent canopies is to attain height growth as quickly as possible. Height increment varies with the species, age and environment. It may be as much as 6 feet a year in Terminalia ivorensis in youth, or 1 or 2 feet in many other species. Only when the tree has reached the upper canopy, or near to it, does it put on good girth increment. At this stage, the bole is very conical, but from now on it becomes more cylindrical. It may be said to put on middle age spread! Girth increment is also governed by the density of the crop. In untouched forest it may be only $\frac{1}{4}$ to $\frac{1}{2}$ inch a year at breast height, or at a point 1 foot above the convergence of the buttress roots.

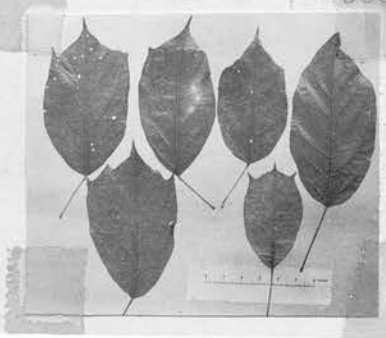
Growth rings are to be found in many trees of the High Forest, but they cannot be relied upon as being annular rings. So, they are of ne real value as an estimate of age. Climatic conditions do not impose the necessity for a resting period. It is different in the Savannah-Woodland, where rings are almost certainly annual. There the comparatively long dry season is in marked contrast to the rainy period.

Seedlings of High Forest dicotyledonous tree species show either hypogeal or epigeal germination. The type of germination is always true for a particular species, but is not necessarily uniform for the family. The Meliaceae shows both forms of germination - Entandrophragma and Khaya are epigeal, whereas Guarea and Turraeanthus are hypogeal. It might be expected that hypogeal germination would be adopted by the plants with particularly large seeds. This is not the case in Mimusops heckelii, whose stout hypocotyl carries the thick, large cotyledons some 4 inches above the ground.

The cotyledons may enlarge and become foliaceous, as in Strombosia pustulata, and in the extreme case of Canarium schweinfurthii, where they are deeply lobed. In Celtis scottellioides, the foliaceous cotyledons are early caducous, but in Funtumia elastica they may persist for some time. The hypocotyl is usually thicker than the shoot immediately above it in the initial stages of the seedling. It is sometimes brown whereas the young



Evolution of the compound leaf in Entandrophragma angolense.



Sapling leaves of Sterculia elegantiflora.

shoot is green in most cases.

Seedling leaves may vary considerably in shape from the adult ones of the species. In some plants with spiral or alternate phyllotaxis, it is not unusual for the first two true leaves to be opposite. This is the case in Ricinodendron africanum. In Cola acuminata they are alternate. With some compound leaved trees, the primary ones are simple, e.g. Khaya ivorensis. The first leaf of Cylicodiscus gabunensis is paripinnate and the second one bipinnate, and so on progressively until bipinnate ones like the mature ones are produced.

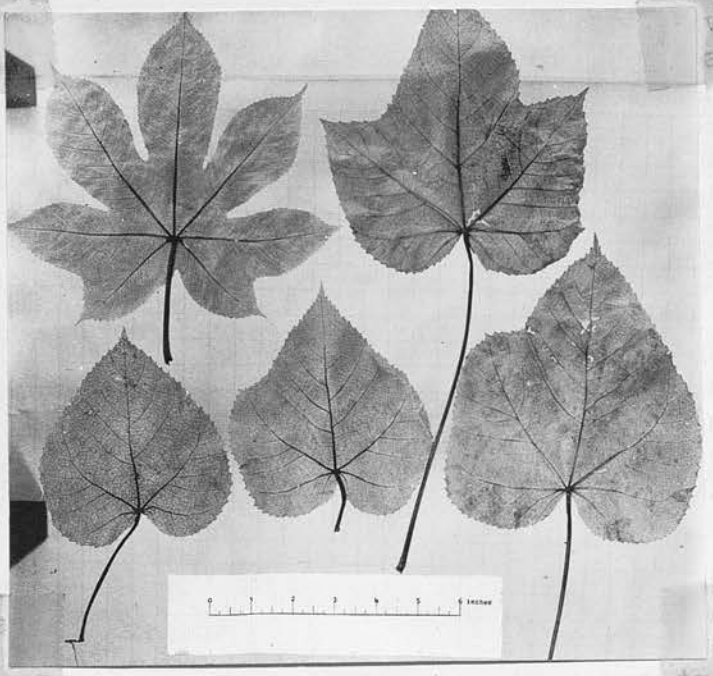
The development of the compound leaf from the simple leaf may be direct or by stages. About the first eight leaves of the Lannea welwitschii seedling are simple. Then a trifoliate leaf is produced, and the next ones are imparipinnate, being the same type as the adult leaves, but the leaflets are not quite the same shape at first.

In Entandrophragma angolense, the development of the compound leaf can be seen in the individual leaves. The first few leaves are simple, and they increase in size until a metamorphosis is indicated in the most recent one. This is shown by either a lug developing from one side of the base of the lamina, or a malformation of the apex. Changes follow rapidly in successive leaves, and the development of a rhachis and leaflets can be observed. Musanga cecropioides provides an example of the development of the digitate leaf from a simple one. The stages in the development are regular, and so no grotesque shapes occur.

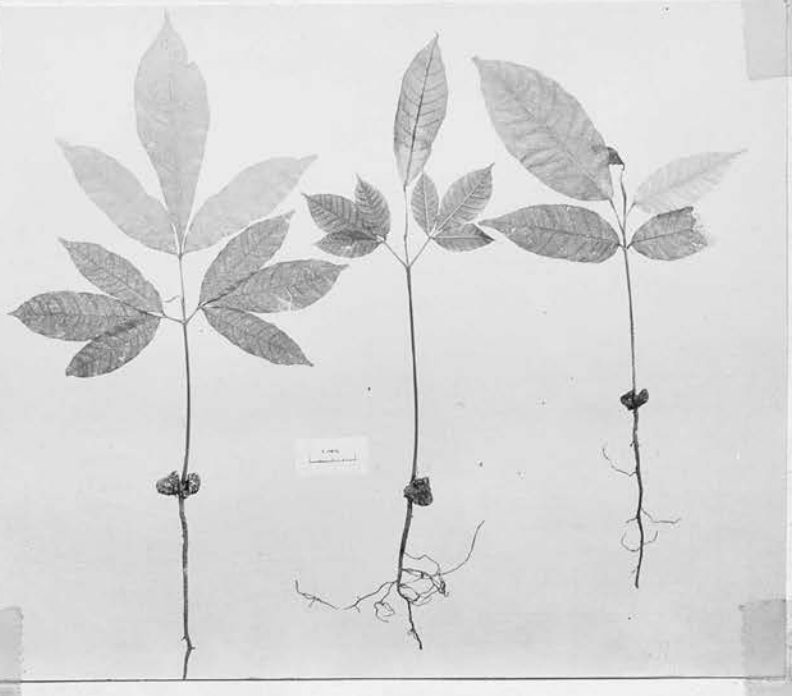
With the genus Entandrophragma and in others which also start life with simple leaves, the development of their compound leaves is hastened by the admission of more light. But once a paripinnate leaf is formed in an Entandrophragma seedling, there is no retrogression. This is not the case with Guarea cedrata and Tarrietia utilis. Under conditions of insufficient light, the first leaves in both species are likely to be simple ones. If, on germination, light conditions are adequate, then the first leaves are trifoliate, and later ones are imparipinnate in Guarea and digitate in Tarrietia. Another peculiarity that T. utilis shows is that if light conditions worsen while the seedling is in its early stages, then a simple leaf may follow a compound one.

Sterculia elegantiflora has a regular, simple, primary leaf. But the seedling and young sapling stages of this species bear "horned" leaves, which vary somewhat in shape amongst themselves with regard to the apical part of the lamina. These gradually give way to normal leaves.

Climbers and lianes are characteristic of the Tropical High



Evolution of the compound leaf in Musanga cecropioides.



Seedlings of Guarea cedrata showing simple & compound leaves.

Forest, but are absent or rare in the open Savannah-Woodland. A liane usually associates itself with a tree while the latter is in its younger stages. From one tree it may spread to others and so produce a tangle. In general it may be said that a liane does not grow up a tree, but with it. Many of the lianes belong to the Apocynaceae. Their stems may be 18 inches in girth, but are usually smaller. In some cases they may exert a constricting effect on the boles of trees and so cause malformation, and maybe death in extreme cases. A climber which does grow up the boles of large trees and does not spread from one to the other is the big leaved Culcasia angolensis.

PART II. VEGETATION.

INTRODUCTION.

In this study of the vegetation types of the Gold Coast, the basic principle adopted is that used by Tansley (41). This is "the 'dynamic' point of view which is simply the explicit recognition that natural and semi-natural vegetation is constantly changing, that certain uniformities in the direction, methods and causes of change can be detected, and that positions of relative equilibrium are reached in which the conditions and composition of the vegetation remain approximately constant for a longer or shorter time. Such a position of relative stability is here called a 'climax', whether it represents a major community corresponding with a climatic region and primarily determined by climate, or a minor community determined by some other factor or combination of factors". Too often the terms 'climate' and 'climax' are treated with some degree of synonymity, whereas they have separate Greek derivations. Thus ecologically we may have climatic, biotic or edaphic climaxes, depending on the nature of the master factor influencing the vegetation.

Some very favourable, localised condition may produce a post-climax vegetation, composed of a more exacting community. Within the climax there may be communities which have not attained the nature of the climax; such a community is a pre-climax, and is more frequent than the post-climax.

Formation is used in a physiognomic sense; it is a mature vegetation type having the same life forms, e.g. the tall trees of the High Forest or the smaller and more branched trees of the Savannah-Woodland are separate formations. The Riverain Forest found in the southern Savannah-Woodland of the Gold Coast belongs to the same formation type as the High Forest, on the basis of physiognomy.

An ecotone is a transition zone between two plant communities, irrespective of their degree. It is a merging of the two types in juxtaposition. Except where edaphic or biotic conditions may be very dominant, the ecotone is a usual occurrence in natural vegetation. In mapping vegetational types, it may be necessary to disregard the ecotone where it is a blending of two adjacent types and occupies no great depth.

Forest and woodland are separated by stature and density of stocking usually. Tall trees with a high stocking constitute

forest under normal conditions, whereas in woodland the trees are shorter and usually more widely spaced. By savannah is understood a continuous grass ground flora. Vegetation springing up after a disturbance of the original crop is termed secondary.

In this study, vegetation type is used to denote major differences in floristic composition within a formation. A vegetation type may consist of one or more associations. By association is meant a unit of vegetation dominated by more than one species. It is easy to appreciate the significance of this term when used in the ecology of temperate lands, but it is a controversial matter in tropical forest ecology. The basic reason for this is that the dominants in tropical vegetation are usually very numerous; in fact its complex nature makes it difficult sometimes to decide what are the typical dominants. The view taken here is that it is more than just convenient to accept the existence of associations in tropical ecology. As the tropical forest contains a great variety of species, it is only reasonable to expect that the vegetational unit must necessarily cover a large area if it is to be as representative as possible. The comparable unit in temperate vegetation to express an association is obviously very much smaller because of the relatively few dominant species involved. These may be only two, but if two are chosen to express a tropical association, they are usually intermingled with many others. Another difficulty in tropical forests is that the name species of an association may be found scattered within other associations. The reader is thus asked to bear in mind the complexity of tropical vegetation, the large area that is necessary in most cases to express a representative vegetational unit, and that the term association is used in a wider sense than in temperate ecology.

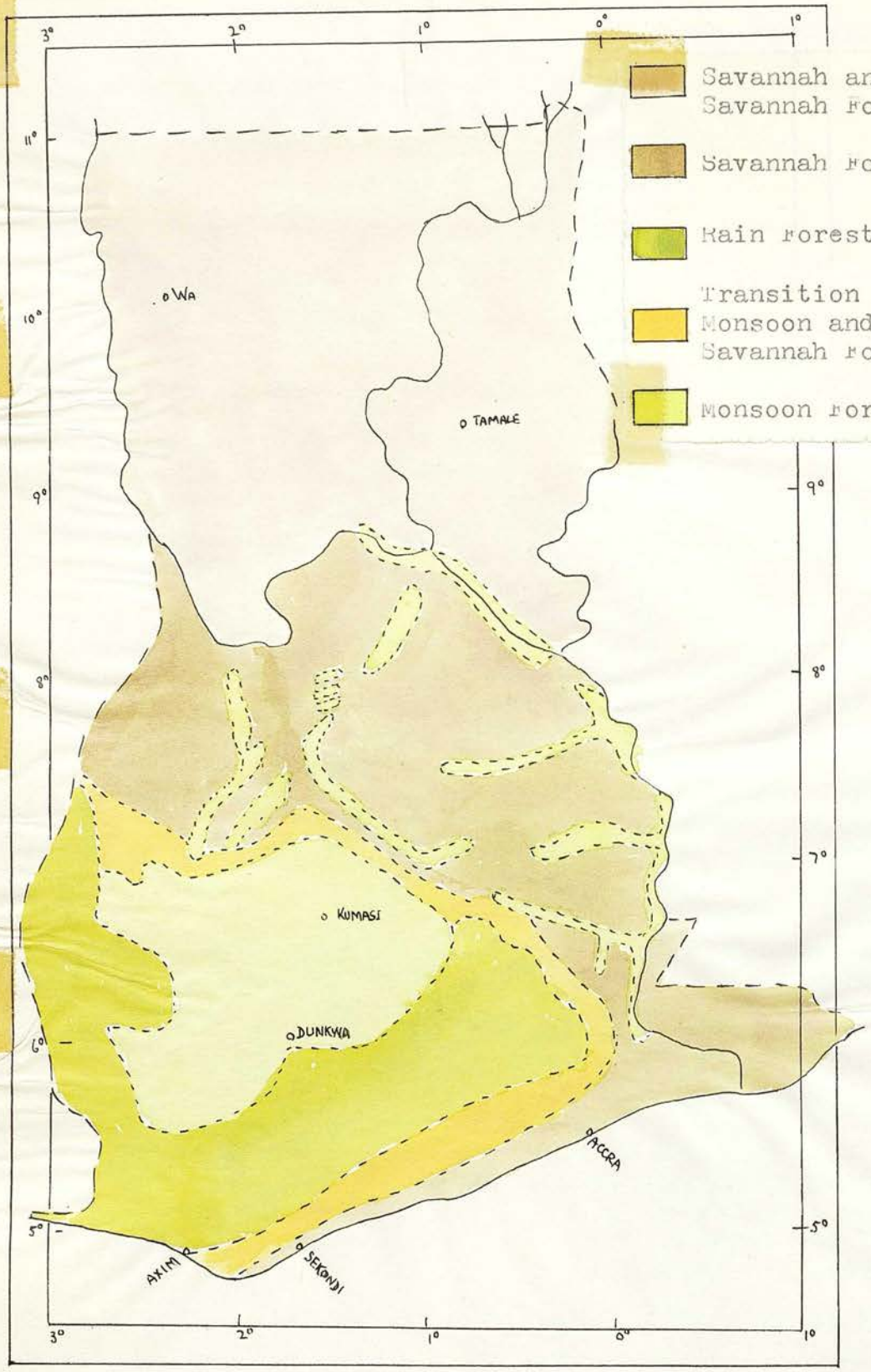
It may be mentioned here that French ecologists and foresters are not in agreement about the application of the term association to West African forests. In 1950, Mangenot (16) confirmed his 1948 opinion that associations could be recognised in tropical high forest, but claimed that this was the first time that this notion of the association could be applied with precision to such a forest. He said that the doubts of some botanists on this subject arose from an insufficient analysis of the vegetation and also from its complexity due to the very great numbers of species and their scattered distribution. Aubréville (5) considers that the term is likely to lead to confusion and he does not advocate its application.

Other ecological terms are defined as follows:

Consociation is a unit of vegetation dominated by one species.

A minor community dominated by species not dominant themselves in the main community is a society.

A sere is a stage in the development or succession of vegetation. A sere is not stable but is regarded as a phase



The approximate distribution of the various types of vegetation on the Gold Coast.
According to H.N.Thompson.

leading to the climax.

A plant community is a collection of plants occupying a similar habitat.

Associes, consocies and socies are seral forms of the association, consociation and society.

An alterne is an area where the conditions of habitat change so suddenly that there is an alternation of one type of plant community with another. Where there is an indiscriminate mixing of species belonging to two distinct communities, the result is a mictium.

Storey or layer is a grouping of plants with similar maximum height growths.

PREVIOUS CLASSIFICATIONS OF THE GOLD COAST VEGETATION.

H.N.Thompson (43) made a rough classification of the vegetation following his six months' visit to the Gold Coast in 1908. Briefly his classification was as follows:

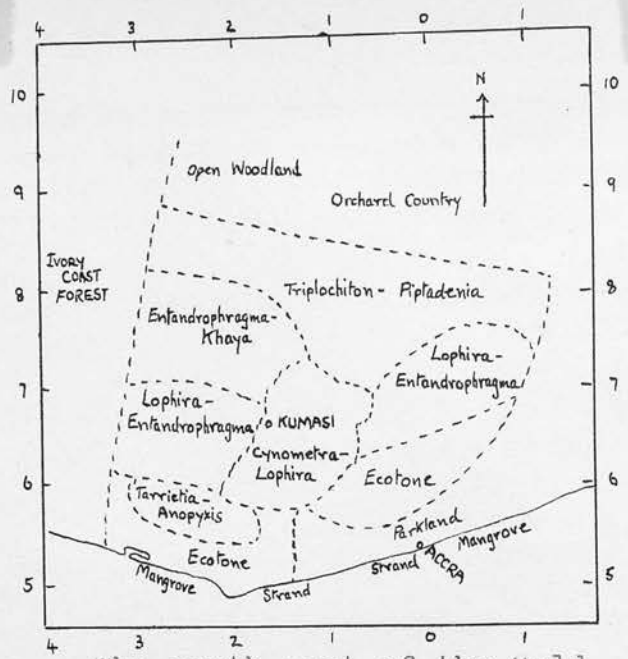
A. The Rain or Moist Tropical Evergreen Forests.
B. The Freshwater Swamp Forests. An edaphic formation.
C. The Monsoon or Mixed Deciduous Forests.
D. Savannah Forests.
E. Savannahs. Trees practically absent.

Mention was made of Mangrove Forest at the mouths of the Ankobra, Tano and Pra Rivers, but it was considered to be not strongly represented.

Thompson said that the difference between A and C was mainly one of deciduousness. A sketch showing Thompson's "Approximate distribution of the various types of vegetation on the Gold Coast" is reproduced here.

Up to the present (1952), the only ecological study of the Gold Coast was that carried out by T.F.Chipp. He was a Forest Officer, and his results were published in 1927 (11). Chipp's ecological divisions were as follows:

1. Monsoon Climax. Closed forest not subject to inundation.
   (a) Cynometra-Lophira Association.
   (b) Three Pre-climaxes are given:
      (i) Lophira-Entandrophragma Pre-climax.
      (ii) Entandrophragma-Khaya "
      (iii) Triplochiton-Piptadenia "
   (c) Four seral units are recognised, all subject to inundation.
      (i) The Grass (Lagoon Marsh) Associes.
      (ii) Tarrietia-Anopyxis "
      (iii) Chlorophora-Landolphia "
      (iv) Calamus-Ancistrophyllum-Raphia (Palm) Associes.



The south-west of the Gold Coast, showing general spatial distribution of the chief types of vegetation.

According to T.F.Chipp.

2. Sudanese Climax. Parkland.
   Two types are recognised:
   (a) Orchard Country - trees isolated in grassland.
   (b) Open Woodland - trees forming open woodlands in grassland.

3. Edaphic Climax. Maritime vegetation - subject to maritime influence or actual sea water.
   Two associations:
   (a) Rhizophora-Avicennia (Mangrove) Association.
   (b) Ipomoea-Cyperus (Strand) "

Chipp's "general spatial distribution of the chief types of vegetation" is shown here. Any criticism that is offered is not against the three formation types but for other two reasons. Firstly, the Cynometra-Lophira Association has been applied to cover a much larger area than that occupied by those two species. Secondly, the preclimaxes appear to be rather unreal and not easily recognisable on the ground or from statistical analysis.

PROPOSED CLASSIFICATION OF THE VEGETATION TYPES.

This classification is based on physiognomy:

1. Tropical High Forest.
2. Savannah-Woodland.
3. Coastal Scrub and Grassland.
4. Maritime.

The zonation of these formations is shown on the map at Appendix 4. This has been prepared from personal reconnaissances and from Gold Coast Forestry Department records, mainly enumeration surveys.

Leptaspis cochleata.

I. TROPICAL HIGH FOREST.

This is a climatic climax where the dominant members of the vegetation are tall trees. The climatic conditions include relatively high temperatures, a plentiful rainfall without prolonged dry periods and high relative humidity. The natural vegetation is closed high forest with a storeyed structure, where the tree finds its greatest development. Grasses are almost absent except for the broad leaved species Leptaspis cochleata and Streptogyne gerontogea and one or two others. These named are shade bearing grasses, with a striking similarity to each other, and seldom growing higher than about 2 feet. They occur as sporadic communities in the forest. Their distribution is not understood, but it has been observed that where they are found, conditions are suitable for natural regeneration of trees under the Tropical Shelterwood System. Other grasses occurring in the more open places in the High Forest (e.g. logging tracks) are Centotheca, Cyrtococcum. Olyra latifolia, Oplismenus and Panicum. There is also the bamboo, Oxytenanthera abyssinica - doubtfully indigenous - growing near streams. Coix lachryma-jobi is found in wayside pools.

The herbaceous layer, or ground flora, is sparse. In the damper areas are pteridophytes, amongst which are the ferns Gleichenia linearis, Lygodium microphyllum and L. smithianum; also Lycopodium cernuum (Lycopodiales) and Selaginella myosurus (Selaginaceae).

The shrub layer comprising woody plants up to about 6 feet or slightly more in height, is variable in density. Often it may be more or less absent, and this is quite typical of old forest. At other times the shrubs may be so plentiful that they help to justify the travellers' tales of "dense, dark, impenetrable forest". Typical shrubs are:

Cnestis ferruginea	Ochna kibbiensis
Eugenia obanensis	Ouratea flava
Leea guineensis	Sphenocentrum jollyanum

In the tree crop three storeys are recognised. There is a closed lower canopy in which the trees are typically heavy crowned and branched. They do not reach a height much greater than 60 feet. Common lower storey trees are:

Carapa procera	Microdesmis puberula
Cleidon gabonicum	Monodora myristica
Conopharyngia chippii	Myrianthus spp.
Corynanthe pachyceras	Randia spp.
Desplatzia subericarpa	Trichilia heudelotii
Mareya spicata	T. prieuriana.

Lianes in young Secondary Forest.

Above this is the upper storey, also with a close canopy. The trees are up to about 130 feet high, and typically have tall straight stems, and many are small crowned. A few of the species are:

Albizzia ferruginea	Hannoa klaineana
Bosquiea angolensis	Mansonia altissima
Bussea occidentalis	Pachypodanthium staudtii
Calpocalyx brevibracteatus	Strombosia pustulata

Lastly there are the emergents, which may reach a height of up to 200 feet; they do not form a closed canopy. Amongst the emergents are found many of the present day economic timber trees such as Entandrophragma, Khaya, Mimusops and Triplochiton. Other emergents are:

Anopyxis ealaensis	Chlorophora excelsa
Antiaris africana	Cylicodiscus gabunensis
Bombax buonopozense	Lophira procera
Canarium schweinfurthii	Piptadenia africana
Ceiba pentandra	Terminalia superba

Entwined through the crop are lianes and creepers. Common lianes are:

Alafia barteri	Combretum comosum
Baissea multiflora	C. platypterum
Bandeiraea simplicifolia	Landolphia owariensis
Clerodendrum spp.	Strophanthus spp.

These lianes are more evident in young Secondary Forest where they spread from the crown of one sapling or pole to another. The effects of climber cutting in mature forest (a normal silvicultural operation) can be seen at least 15 years afterwards; the only noticeable regrowth is of Culcasia spp. which grow up the bigger trees, but do not attempt to go from one to the other.

Some species of Ficus, e.g. F. leprieuri, may begin life as epiphytes, but after a while they become rooted in the ground. True epiphytes are to be seen growing in the crowns of the emergent trees and they are mainly pteridophytes and orchids. Some of the more common ones are:

Filicales.	Orchidaceae.
Arthropteris orientalis	Bulbophyllum spp.
Dynaria laurentii	
Microsorium punctatum	
Platycerum angolense	Cactaceae.
P. stemaria	Rhipsalis

These epiphytes would provide an interesting physiological study, for in those cases where they grow on deciduous trees,

they must be subjected to two different atmospheric conditions - a very sheltered and humid environment amongst the tree leaves for most of the year, and when the tree is leafless, especially in the northern parts of the High Forest Zone, they occupy a position exposed to the desiccating effects of the harmattam. However, their xerophytic adaptations appear to cope with both conditions.

Parasitic plants are not common in the High Forest. The sémi-parasites, Loranthus spp., are to be seen in the crowns of some trees. Thonningia sanguinea, a root parasite often on Triplochiton scleroxylon, but not confined to this tree, is conspicuous where it occurs on the forest floor because of its bright red colour.

Throughout the lower storeys are to be found seedlings, saplings and poles of trees belonging to the upper storeys.

The forest is a heterogeneous collection of uneven aged trees. Over a large enough area it is usually possible to find representatives of all the age classes. This unit may be quite large, for it is not uncommon to find places occupied by a larger proportion of a particular age group. This has given rise to the concept that the tropical high forest is made up of mosaics, each of which owes much of its regeneration to a certain period. Aubréville (2) describes this theory of mosaics or cyclical succession. Richards (35) defines it thus: "The differences in size- (and age-) class representation between different rain-forest trees are doubtless a matter of specific (hereditary) idiosyncrasy. They depend on the reproductive behaviour of the species and also on the ecological tolerance (temperament) of its young stages".

Some of these mosaics are obvious in the forest where there is a definite preponderance of a particular age group. About the most conspicuous is that of a "pole crop", with a high proportion of stems up to about 5 feet girth B.H., and few old trees. A possible reason for this, or at any rate, a factor governing it, may be caused by a group of trees dying of old age within a relatively short space of time. In such an "over-mature" forest, there is a deviation from the normal stratified pattern, for the lower canopies contain fewer trees. An example of this occurs (1952) in the north-east of the Subri Forest Reserve.

Richards (35) says "The Tropical Rain Forest is in a state of equilibrium and although the floristic composition may vary locally over a period of years, the general composition of the forest is not much changed. However, there seems to be some sort of cyclical succession". It is suggested that there are periods - perhaps covering many years - when some species have a maximum capacity for regeneration. Two examples which seem to give this theory some support are Afrormosia elata and Entandrophragma angolense. The younger age classes are very

poorly represented at present (1952), and in fact they contain fewer trees than the older age classes. In the Bobiri F.R., E. angolense is poorly represented in the lower girth classes. However, in the areas now being treated under the Tropical Shelterwood System, this species is common in the regeneration, and its growth has been recorded as vigorous.

The High Forest has been divided into two types - (a) Rain Forest, (b) Moist Semi-Deciduous Forest. This division has been made on a floristic basis, for there is no other significant difference between these two types except in the increasing degree of deciduousness from south to north.

THE RAIN FOREST.

The Rain Forest is situated in the south-west. It lies in an area of high rainfall and very high relative humidity. The harmattan has no real effect here. The annual rainfall is from 70-120 inches and there is no month without rain. The country is generally low lying, but contains numerous, small, steep hills with frequent swamps in the valleys.

This is the only case where the High Forest now reaches the sea (1952) - on the rising ground in the vicinity of Cape Three Points. Further west it is never far from the sea, being separated from it by a belt of lagoons and coconut plantations.

Only one association is recognised in this type - the Cynometra-Lophira-Tarrietia Association. It is true that C. ananta, L. procera and Tarrietia utilis do occur outside this type, but within it they attain their maximum development. T. utilis may be semi-gregarious, with a sporadic distribution, but it is considered a significant tree of the Rain Forest.

The Rain Forest has an evergreen aspect throughout the year. It is only during a short period (November to January) that deciduous trees may be seen in the emergent and upper canopies. These are species which are not confined to the Rain Forest, such as Bombax, Ceiba, Entandrophragma and Khaya. Evergreen trees are Cynometra, Lophira and Tarrietia. Leaf-fall of these trees takes place once or twice a year, but the new leaves are produced just before or simultaneously, and so the trees are never bare. Flushing of the new leaves is particularly conspicuous in Cynometra and Lophira because of their vivid red colour in the young state. The lower storey and shrub layer are evergreen.

The Rain Forest is numerically rich in species. An enumeration survey in the Ankasa River F.R. (Appendix 5) on an area of 120 acres records 3,970 trees of 3 feet girth B.H. or more (33 per acre) and representing 90 species. In addition there are the numerous species which do not reach a girth of 3 feet.

Celtis spp., Cola cordifolia, Pterygota macrocarpa, Sterculia rhinopetala and Triplochiton scleroxylon are absent, but are common trees of the Moist Semi-Deciduous Forest.

Typical Rain Forest trees include:

UPPER AND EMERGENT STOREYS.

Cynometra ananta	Bophira procera
Daniellia thurifera	Parkia bicolor
Dialium aubrevillei	Piptadenia africana
Erythrophleum ivorense	Tarrietia utilis

LOWER STOREY

Allanblackia parviflora	Diospyros sanza-minika
Berlinia spp.	Funtumia africana
Calpocalyx brevibracteatus	Pentadesma butyracea
Cola chlamydantha	Protomegabaria stapfiana
C. maclaudii	Strombosia pustulata

(S. pustulata attains its maximum development in this type and may reach the upper storey).

The shrub layer is often sparse; typical species are:

Bertiera racemosa	Mussaenda chippii
Heisteria parvifolia	Randia hispida

Herbaceous plants are rare, but Scleria barteri (Cyperaceae) may form tangles where the tree canopy is more open than usual. In some cases the forest is remarkably free of lianes (e.g. parts of the Ankasa F.R.).

In about 1891 exploitation began in the Rain Forest for export mahogany (Khaya ivorensis) and cedar (mainly Entandrophrarma angolense and E. cylindricum). For some 40 years the timber trade confined most of its activities to this region because of the nearness of the sea, and convenience of water transportation down the Ankobra and Tano Rivers. The remainder of the High Forest was then not so easily accessible on account of its distance from the sea and the lack of water transport and the comparative paucity of rail facilities.

The Rain Forest was thus "creamed" of its mahogany and cedar, and to a lesser extent such trees as Guarea, Lovoa and Mimusops. Present day enumeration surveys reveal a particular scarcity of Entandrophragma and Khaya, especially in the older age classes, but also in the younger ones. In fact, there are areas of the Rain Forest where trees of the two genera, Entandrophragma and Khaya are now rare, e.g. Ankasa River, and Cape Three Points F.Rs. and the S.W. part of the Subri F.R. Large areas may be termed Depleted Forest. This term has been used by Richards (35) with

the following explanation: "Areas of primary rain forest subjected to selective exploitation of timber (selection felling) may be termed depleted forest. The gaps left by the removal of the timber trees become colonised by secondary forest species and the community thus comes to consist of a patchwork of primary and secondary forest of very irregular structure".

THE MOIST SEMI-DECIDUOUS FOREST.

Physiognomically this type is the same as the Rain Forest, but it differs from it floristically and shows a greater degree of deciduousness. Various attempts have been made to give this forest a suitable name. Although the term "Moist Semi-Deciduous" is not ideal, it is considered descriptive. For varying periods between October and April many of the species in the emergent and upper canopies are deciduous. The application of the term semi-deciduous requires an explanation. Although certain trees of the upper and emergent storeys shed their leaves during the period which coincides with the dry season, they are not all deciduous at the same time, nor are all trees of the same species deciduous together.. In many cases there is some linkage to the sexual condition of the tree. One example may suffice here - the conspicuous emergent tree Ceiba pentandra. Shortly after leaf shedding, one branch may produce new leaves. This branch will not bear flowers, but the others will. New leaves will not be formed on the reproductive branches until fruiting is over, or nearly so.

The lower storey is evergreen, including almost all the young trees of the species belonging to the emergent and upper canopies. The general atmospheric conditions under this canopy are moist.

The Moist Semi-Deciduous Forest occupies about 90% of the area of the High Forest. The annual rainfall is from about 50-70 inches, although this may be exceeded in some of the higher altitude areas. The rainfall distribution shows two peaks - in May-June and September-October. The dry season from about December to February becomes more evident on going northwards. But within the forest the relative humidity is high throughout the year.

Much of the country lying within this forest type is over 500 feet above sea level.

The structure of the forest is similar to that of the Rain Forest, except that in the north the trees tend to form two storeys and not three. The shrub layer is often denser than in the Rain Forest and the herbaceous plants are more obvious but not abundant.

The principal families represented in the upper and emergent canopies are the Leguminosae, Meliaceae, Moraceae, Sapotaceae, Sterculiaceae and Ulmaceae.

Three associations are recognised:

(a) Lophira-Triplochiton Association.
(b) Celtis-Triplochiton "
(c) Antiaris-Chlorophora "

(a) LOPHIRA-TRIPLOCHITON ASSOCIATION.

This occurs as a narrow belt, some 10-30 miles broad, to the north and north-east of the Rain Forest. There is an outlier on the top of the Atewa Range, about 50 miles to the north-east. There an altitude of 2,420 feet is recorded. This association is really the ecotone between the Moist Semi-Deciduous Forest and the Rain Forest. Thus it is not surprising that Celtis and Triplochiton are found in mixture with Cynometra, Lophira and Tarrietia. Just as the typical Rain Forest trees become scarce towards the north, so do Celtis and Triplochiton decrease towards the south.

The Leguminosae are those found in the Rain Forest except that Daniellia similis takes the place of D. thurifera and and Cynometra ananta and Parkia bicolor become less common. Lophira procera and Tarrietia utilis show a preference for the damper situations. Celtis adolfi-frederici, C. soyauxii, C. zenkeri and Triplochiton scleroxylon make their appearance. The Sterculiaceae show a change in Tarrietia utilis becoming occasional or rare, and in the presence of Cola cordifolia, Pterygota macrocarpa and Sterculia rhinopetala, and also Cistanthera papaverifera in the drier areas. The Meliaceae remain the same as in the Rain Forest, but specimens of Entandrophragma, Khaya and Lovoa are more numerous. This may be due to less timber exploitation having taken place here. In the Moraceae, Antiaris, Bosquiea and Chlorophora become more frequent.

The lower storey trees Cola chlamydantha, Diospyros sanzaminika, Funtumia africana and Protomegabaria stapfiana are still present but less frequent. Corynanthe pachyceras and Hymenostegia afzelii come in. Strombosia is still present in quantity but in general it is not quite as big a tree as in the Rain Forest.

An enumeration survey in the Kakum F.R. (Appendix 6) recorded 4,993 trees (33 per acre) over 3 feet girth B.H. on an area of 150 acres.

(b) CELTIS-TRIPLOCHITON ASSOCIATION.

Except for a strip on the south-east, this association occupies the remainder of the High Forest area south of the line of the Kwahu and Mampong (Ashanti) Scarps and its continuation

north-westwards. It covers about half the area of the High Forest Zone.

The Celtis-Triplochiton Association is the climatic climax vegetation of the Moist Semi-Deciduous Forest.

Although Celtis adolfi-fredericî, C. soyauxii and C. zenkeri and Triplochiton are found throughout the Moist Semi-Deciduous Forest, it is within the association now being considered that they attain their greatest development and frequency. Of the Rain Forest trees, Tarrietia is absent. A small group of Lophira procera is known to occur near Mile 77 on the Wiawso-Jabeso road, and two mature specimens have been seen about 16 miles N.E. of Kumasi. Similarly there are small groups of Cynometra ananta near Dunkwa. The occurrence of these trees outside their normal range seems to be due to edaphic reasons; so their presence in this association is of no real significance.

In the Meliaceae, Lovoa becomes rare, while Entandrophragma utile makes its appearance, particularly in the north, and Khaya anthotheca is found towards the west. In the Leguminosae, Piptadenia remains frequent but Parkia becomes rare; Cylicodiscus gabunensis is a newcomer, but is absent in the south. Members of the Sterculiaceae become more common (except for the disappearance of Tarrietia); amongst the emergent and upper storey trees are Cistanthera papaverifera, Cola cordifolia, Pterygota macrocarpa, Sterculia elegantiflora, S. rhinopetala and Triplochiton, while Mansonia altissima is particularly evident in the north.

In the lower storey, Corynanthe pachyceras, Hymenostegia afzelii, Lecaniodiscus cupanioides, Monodora myristica and Myrianthus spp. are frequent, and also Sterculia tragacantha. Carapa procera is common, especially in damp situations. Strombosia is generally a smaller tree than further south. Cola chlamydantha is absent except in the south-west of this association, e.g. the Tano valley. Diospyros sanza-minika and Protomegabaria stapfiana are virtually absent but for some individuals in the south-west. Funtumia africana is replaced by F. elastica.

Amongst the shrubs, Bertiera has disappeared; Mussaenda chippii with its white sepal is rare; its place is taken by M. erythrophylla with its conspicuous and well developed red sepal. There is a saying in Ashanti that when the red Mussaenda becomes more common than the white one, then warfare will cease there. However, this vegetational change is unlikely to occur unless the climate becomes wetter.

This association is numerically rich in tree species. Type enumerations carried out in the Bobiri and Onuem-Nyamibe F.Rs. are given in Appendices 7 & 8. About 100 species of trees with

girths of 3 feet B.H. or more are recorded in the Bobiri F.R. on 94 acres. With a total of 3,336 trees, the frequency is about 35 to an acre.

The principal cocoa growing areas of the country are situated in this association. Since about 1940 it has also received much attention from timber merchants, and large areas are being exploited. The effects of these industries on the natural vegetation will be discussed later.

(c) ANTIARIS-CHLOROPHORA ASSOCIATION.

The northern limits of the High Forest, the Togoland High Forest and the strip on the south-eastern margin of the High Forest Zone are included in the Antiaris-Chlorophora Association. This is sometimes referred to as the dry type, but the term is misleading. Parts of this association, especially on higher ground, receive a greater rainfall than some areas in the Celtis-Triplochiton Association. The question of water availability becomes important here, for the northern limits of this association are more exposed to the drying effects of the harmattan than the forests to the south. Another factor to be considered is that the soils from the Voltaian sandstones which occur in the north are probably less retentive of water than clay soils.

Unlike the Lophira-Triplochiton Association, the Antiaris-Chlorophora Association is not really an ecotone. Those marginal parts of it, which no doubt at one time fell into the category of an ecotone, have disappeared because of fires caused by man for hunting and farming purposes. The limits of this High Forest association with its next lower formation (the Savannah-Woodland) are either abrupt or form alternes, especially on hilly ground. Where the topography is fairly level, mictia may occur.

Along the Scarps and in Togoland, Celtis may be locally rare. Elsewhere, Celtis and Triplochiton are still common, but C. soyauxii may be less frequent along the northern margins.

Although Celtis and Triplochiton are the most common trees, this forest forms a sub-type, but with a rather uneven distribution in some species. Antiaris africana and Chlorophora excelsa are well developed and more frequent in the sub-type than elsewhere in the High Forest Zone.

Except in the south-east, Khaya ivorensis is replaced by K. grandifoliola; K. anthotheca occurs along the southern margin in the west. Entandrophragma spp. are absent from Togoland, but occur throughout the rest of the association. Lovoa is absent. Of the Leguminous trees, Piptadenia becomes rare on the northern margin and in Togoland, and Cylicodiscus is absent from those

Transition from High Forest to Savannah-Woodland.

parts and from the south-east. Afrormosia elata has a fairly restricted distribution in the west. The Moraceae - Antiaris, Chlorophora and Morus mesozygia - and the Sterculiaceae - Cistanthera, Cola cordifolia, Mansonia (rare in Togoland), Pterygota, Sterculia elegantiflora, S. rhinopetala and Triplochiton- are well represented; so are the genera Aningueria and Chrysophyllum of the Sapotaceae.

The under storey species are those of the Celtis-Triplochiton Association, with the addition of Chidlowia sanguinea (also occurring as individuals in the northern part of the latter association) and the apparently endemic Talbotiella gentii. From specimens collected, it would appear that Funtumia africana occurs in Togoland and not F. elastica.

The physiognomy of this association differs slightly from the remainder of the High Forest. There are but two recognisable tree storeys, for the upper and emergent ones tend to merge. Even then , the result is usually a more broken canopy than the more or less closed upper canopy found in other parts of the High Forest.

There is no doubt that the Antiaris-Chlorophora Association extended further to the north and south east than it does today (1952). This is discussed later. When Thompson (43) visited the Aburi Hills (S.E. limits of the Association) in 1908, he reported that "....the remnants of the old forest can still be seen in the form of large isolated examples of Piptadenia africana, Triplochiton scleroxylon, Antiaris africana, Chlorophora excelsa, Parkia bicolor, Ficus spp., Ceiba pentandra, Bombax buonopozense, Terminalia superba, Anopyxis ealaensis, Mimusops heckelii, etc. left as standards in farms on account of their size". He also noted the secondary growth of Musanga cecropioides, Myrianthus arboreus, Harrungana madagascariensis, Elaeis guineensis, Anthocleista nobilis and Terminalia ivorensis. Also that the devastation of the hillsides was proceeding rapidly.

II. SERAL COMMUNITIES IN THE HIGH FOREST ZONE.

EDAPHIC.

Three main seral units are recognised, all occurring in freshwater swamps where the high water table is the result of low relief.

(a) Mitragyna Consocies. This exists in two forms - M. ciliata in the Rain Forest and Lophira-Triplochiton Association, and M. stipulosa elsewhere in the High Forest. The only significant differences are the geographical distribution and M.ciliata being a larger tree of about 80 feet high.

This consocies is found in swamps which are not deep and which may or may not be seasonal. Where they are perennial, pneumatophores may be developed. The crop is usually pure and the stocking dense.

(b) Raphia-Uapaca Associes. As far as has been observed, this associes, represented by Raphia vinifera and Uapaca paludosa, is confined to the Rain Forest, where this large leaved, pubescent Uapaca occurs. Often the swamp is seasonal, but always moist. It is not uncommon to find an occasional High Forest tree growing above the Raphia-Uapaca canopy.

(c) Ancistrophyllum-Calamus-Raphia Associes. This is the commonest edaphic formation within the High Forest. Although seldom extensive individually, these freshwater swamp communities comprise a large aggregate area within the High Forest Zone. Much of the low lying ground bears this associes.

There are cases where the Raphia Palms almost form a consocies, but more often the two climbing palms are also present. The result is a tangle of stems, hooks and prickles, making it uncomfortable for human penetration. The raphia palms do not grow much above 30 feet high, but the other palms are able to climb up tall trees. The canopy is often about 50% open. The ground flora consists of species of Aframomum, Amomum, Costus and Marantachloa, particularly in the more open parts. Very little grows near the Raphia palms. An odd tree may push its way up through this palm community, but it is principally on the margins of these freshwater swamps, where drainage conditions are slightly better, that trees are found. The more common species are Alstonia boonei, Homalium dolichophyllum, Lannea welwitschii, Terminalia ivorensis, and T. superba. In the lower storey are Carapa procera and Cleistopholis patens. Both canopies are very open. Macrolobium limba is sometimes found growing gregariously in these swamps, and also individuals of Nauclea pobeguinii (syn. Sarcocephalus pobeguinii Hua)

a Riverside High Forest, with good drainage.

The composition of the tree crop in the swamps of the Rain Forest are similar to those found in this palm association in the Moist Semi-Deciduous Forest, but more species are represented. These are not necessarily all in the one community. The principal ones are Berlinia bracteosa, Macrolobium splendidum, Symphonia gabonensis and Xylopia staudtii. A common understorey species is Randia lanepoolei. These species are not confined to the margins of the swamps and may be found scattered through them.

RIVERSIDE VEGETATION.

No attempt is being made to describe the riverside vegetation in the High Forest Zone as it has not been studied in detail. Although there are trees such as Cathormion diklagei and and Cynometra megalophylla which are often found on the banks of rivers, they are sporadic in their distribution. Where drainage conditions are good, then normal forest is found along river banks. If drainage is poor, especially where periodic flooding takes place, the vegetation is usually that of the Ancistrophyllum-Calamus-Raphia Associes.

BIOTIC.

The natural High Forest has been disturbed in many ways by man. Before considering these, the following account is given of the succession from disturbed forest.

Secondary forest is the forest which is regenerated naturally after a disturbance has taken place in the forest. Its regeneration is a more rapid process than that going on all the time in untouched forest. In the latter, the most successful regeneration is found in small gaps created by windblows or death. There the conditions of light are such that seedlings of light demanding tree species and shade bearers progress, and the influx of climbers and herbaceous plants is not too great to prevent the success of the tree seedlings and saplings. As is to be expected, the light demanding tree species grow quicker in height than the shade bearers, but it is only in youth that some of these are shade bearers. Later on their growth may be quite rapid when more light is available to them. Some of the light demanders are not long lived trees, and in time their places in the canopy are taken by the quondam shade bearers. In this way the forest is recreated in its own likeness, although the composition of the species on the regenerated plot will vary, most likely, from the previous crop. This may be less apparent in time as competition and other natural causes reduce the unit stocking.

Where larger gaps have been caused by man in the forest, the natural regeneration taking place on them is not quite the same as that described above. The two chief reasons for this -

Secondary forest, after farming.

and they are dependent on the gap being large - are the greatly increased amount of light reaching the ground and the disturbance to the microclimate. The resultant crop, if soil conditions have not degenerated too much, is secondary forest. In the normal way it consists of a succession, passing through seral stages until high forest results. This forest has the same physiognomy as the natural forest, and in the course of time - probably a long time - its floristic composition will be the same and it will have the appearance of primeval forest. However, in its younger stages it is recognisable as Secondary Forest.

Let us consider the succession on a gap not less than 10 acres in extent in the Moist Semi-Deciduous Forest. Also that this area was covered with normal high forest not more than 3 years previously, which was felled and burned to provide an area for a food farm.

The first seral stage occurs immediately after the abandoning of the area by the farmer. The herbaceous plants include species of the Acanthaceae and Commelinaceae and the grasses Centotheca, Cyrtococcum, Oplismenus and Panicum. Climbers and woody plants include:

Climbers	Shrubs and Small Trees.
Acacia pennata	Alchornea cordifolia
Baissea breviloba	Canthium glabriflorum
Bandeirea simplicifolia	Ficus spp.
Combretum spp.	Hoslundia opposita
Momordica charantha	Myrianthus spp.
Mucuna urens	Rauvolfia vomitora
Urera spp.	Solanum verbascifolium.

Trees.

Albizzia gummifera	Ficus spp.
A. zygia	Funtumia elastica
Antiaris africana	Hannoa klaineana
Bombax buonopozense	Musanga cecropioides
Ceiba pentandra	Ricinodendron africanum
Celtis spp.	Terminalia ivorensis
Combretodendron africanum	T. superba
Discoglypremna caloneura	Triplochiton scleroxylon.

Before long the Musanga becomes dominant and forms a consocies. Its height growth is very rapid; it attains a maximum of some 60 feet in about 8 years and usually forms a dense crop. (Musanga is probably the only example of a pure, even-aged tree crop in the High Forest Zone). A certain amount of the initial regeneration of the other species disappears under this Musanga canopy, but some persists. Musanga is a short lived tree, and

within about 20 years the crop has reached the end of its rotation. By that time some of the Musanga will have died and others will follow suit. During the later years of the Musanga rotation, the tree species under it have been taking advantage of increased light conditions, especially in canopy openings, and have been growing in height.

The next seral stage is a pole crop of tree species, mainly light demanders. No young Musanga will be present, for this tree does not regenerate under itself. The species comprising this crop are those listed above, and in addition, many others, such as:

Bosquiea angolensis	Piptadenia africana
Bussea occidentalis	Sterculia elegantiflora
Cylicodiscus gabonensis	S. rhinopetala
Guarea cedrata	S. tragacantha
Nauclea diderrichii	

Within this pole crop may be some relic trees of the original forest, for it is quite usual to find that farming has not destroyed all the trees.

This seral stage is one in which a lot of competition takes place. Young Secondary Forest is created, which apart from its floristic composition, is easily recognised by a preponderance of trees in a particular girth size group. This disparity in the girth classes is less obvious when time has taken the crop into the category of Old Secondary Forest. By then the unequal growth rates and potentialities of the species, and the recruitment of other trees, especially shade bearers, have brought about the heterogenous crop that is typical of the tropical high forest.

From an economic point of view, it is worthy of mention that Entandrophragma and Khaya do not occur in young Secondary Forest, or only in very small quantities.

Old Secondary Forest is a pre-climax vegetation. The next seral stage is when the crop begins regenerating itself in the normal way that primeval forest does, i.e., mostly through gaps occurring in the crop because of windblows and deaths. This seral stage lasts a considerable time, and during its period the regeneration of other species takes place as well as those constituting the crop. Some of them are species which do not usually regenerate in young Secondary Forest. They originate from the adjacent, untouched forest, and come in through the normal agencies of seed dispersal. The resultant crop is the climatic climax vegetation.

A similar succession takes place in the Rain Forest, but the species regenerating under the Musanga are those found in the Cynometra-Lophira-Tarrietia Association.

Clearing of High Forest for farms.

Secondary Forest and cassava farm.

The principal forms of vegetation resulting from biotic factors in the High Forest Zone are described below.

FOOD FARMS - not including RICE.

The usual food farm is a transitory one, resulting from the method of shifting cultivation so widely practised in the tropics. As the farm is usually worked by a family, it is seldom more than about 10 acres in extent. Between October and March, the lianes, shrubs and small trees are cutlassed and many of the trees in the emergent and upper canopies are felled. Towards the end of this period, which coincides with the dry season, the felling debris is burnt in piles. Some of it is packed around the bases of large trees to kill them by fire - such as the huge Ceiba pentandra with its soft wood which is not easily axed, and Cylicodiscus gabunensis with its hard wood and very spreading crown. Planting and sowing of the food crops begin in April with the coming of the rains. Cocoyam (Xanthosoma saggitifolium) tubers and plantains (Musa sapientum var paradisiaca) suckers are planted. Then corn (Zea mays) is sown. Garden eggs (Solanum melongena), okro (Hibiscus esculentus) and pepper (Capsicum annuum) are also sown, and sometimes beans. Yams (Dioscorea spp.) may be grown, but not in any great quantity. In the High Forest Zone they are confined to the northern parts, but are not a typical food crop of the High Forest. Usually only one crop of corn is harvested - about four months after sowing. The garden eggs, okro, pepper and beans are picked as they ripen. After the first year, the farm contains only plantains and cocoyams. These continue to give good crops until the fourth or fifth year, when the farm is usually abandoned.

Such an area may now go through the seral stages described above as Secondary Forest. However, it is likely that the succession will be allowed to continue for a few years only. This period is the forest or bush fallow. Another clearing and burning then take place, and a farm is recreated. The duration of the fallow depends to a large extent on land availability, but it is seldom less than seven years unless near the large towns. The food crops in the second and later rotations are similar to those in the original farm until the soil has degenerated so much that only cassave (Manihot esculenta) can be grown.

As is to be expected, repeated clearing, burning and farming cause a degeneration of the forest crop which appears during the fallows. A significant change is the absence of Musanga, which occurs only in a first fallow on rasonable soil. Its place is taken by the more accommodating Trema guineensis. It is

also a short lived tree but with a slender habit in contrast to the umbrella shape of Musanga. With soil deterioration there is a reduction in the floristic composition of the crop. The vegetation may degenerate until the physiognomy is that of scrub with a few small trees and an occasional big tree as a relic from the former forest. Common species are:

Grasses.	Climbers.
Pennisetum purpureum (a)	Acacia pennata
Setaria chevalieri	Bandeiraea simplicifolia
S. megaphylla	Cardiospermum grandiflorum
(a) usually only on better soils.	Combretum platypterum
	Mucuna spp.

Shrubs and Small Trees.

Albizzia gummifera	Hoslundia opposita
A. zygia	Lonchocarpus sericeus
Alchornea cordifolia	Macaranga spp.
Baphia nitida	Mallotus oppositifolius
Bridelia spp.	Myrianthus spp.
Ficus spp.	Phyllanthus spp.
Funtumia elastica	Rauvolfia vomitora.

Trees - usually relics.

Amphimas pterocarpoides	Piptadenia africana
Bombax buonopozense	Ricinodendron africanum
Ceiba pentandra	Spathodea campanulata
Chlorophora excelsa	Triplochiton scleroxylon
Cylicodiscus gabunensis	

Bombax, Ceiba and Ricinodendron are capable of regenerating in this deflected seral stage or plagiosere.

Similar conditions exist in the Rain Forest but the composition of the species is slightly varied.

COCOA FARMS.

Cocoa farms represent a permanent crop - at any rate a crop which should exist as such for some 40 years under suitable conditions. Cocoa seedlings up to about a year old are planted in the first rotation of a food farm. In about four years' time food farming is brought to an end with the formation of a cocoa plantation with more or less closed canopy. The much branched cocoa trees reach a full-grown height of 15-20 feet. Above them are a few standards left over from the original forest. A ground flora of herbaceous plants develops (ferns are usually common), and very little regeneration of woody species is possible because of the low shade. The quick growing Funtumia may regenerate

Cocoa Farm.

where the canopy is broken. Another cause preventing the regeneration of indigenous species (Theobroma cacao L. is an exotic) is the annual ground cleaning carried out with cutlasses.

The appearance of a cocoa farm is thus 2-storeyed. There is a closed canopy about 20 feet high and a very broken upper canopy consisting of a few small trees and fewer large ones. Where such a structure exists, the cocoa crop has a chance of succeeding, if other factors are suitable for this species. However, the absence of the upper canopy may cause deterioration of the cocoa trees because of the lack of suitable atmospheric conditions during the dry period of the harmattan. When this upper canopy has been destroyed, especially in areas where the desiccating effect of the harmattan may be severe, the degeneration of the cocoa crop is almost inevitable. Such an area occurs in the Antiaris-Chlorophora Association north of Koforidua, in what is usually referred to as the Bisa Area. The Krobos - not a forest people - use a clearfelling method when making farms, whereas the forest dwellers such as the Ashantis, leave standards of indigenous trees in their farms. Krobos moved up to the Bisa Area, and as a result of their farming methods, a very large area north of Koforidua has degenerated to a scrub about 15 feet high, with hardly a tree remaining from the original forest. The cocoa farms have failed.

This area is in marginal conditions for cocoa, being near the Savannah-Woodland, and liable to the desiccating effects of the harmattan coming from the north-east. It may be described as funnel-shaped, with a N.E.-S.W. axis, and the larger, northern end opening onto the Afram Plains. A description was given by Moor in about 1932 (32): "There is little forest left in the locality, but from evidence of the odd trees and patches remaining it is obvious that up to very recent times this part of the country was covered with a deciduous type of forest of good average height and density and with only a narrow transition belt between itself and the grass savannah.

"The present condition is somewhat different. A belt of oil palms, now neglected, created some 50 years ago, has replaced the forest east of the Pawnpawn Su, the greater part of the transition belt has been absorbed by the savannah which has now also thrust a wedge up the valley of the river, and the rest is a mixture of good and bad cocoa farms, areas of oil palms and sporadic patches of savannah and secondary growth, with here and there the remains of the original forest.....From the ages of the dry zone species now established in these patches it is clear that they are of quite recent formation. This savannah intrusion is quite definitely the direct result of successive deforestation."

Moor (32) also records that cocoa was introduced to the Bisa Area in 1908 and that most of the deforestation was completed

by 1920. The first real effects due to the destruction of the forest were noticed in the dry season of 1925-26 when the cocoa trees shed their leaves. This was a new phenomenon as cocoa is an evergreen tree. In 1928 it was recorded that the cocoa was in a pathetic state of die-back.

Much of the present vegetation is made up of the following:

Climbers and Stragglers.

Acacia pennata
Bandeiraea simplicifolia
Byrsocarpus coccineus
Cardiospermum grandiflorum
Clerodendrum polycephalum
Indigofera macrophylla

Shrubs and Small Trees.

Alchornea cordifolia
Anthocleista nobilis
Baphia nitida
Cnestis ferruginea
Elaeis guineensis
Ficus spp.
Grewia spp.
Holarrhena wulfsbergii
Hoslundia opposita
Macaranga sppp
Mallotus oppositifolius
Morinda lucida
Olax subscorpioidea
Rauvolfia vomitora
Solanum verbascifolium
Vernonia conferta

Trees.

Albizzia gummifera
A. warneckii
A. zygia
Antiaris africana
Ceiba pentandra
Chlorophora excelsa
Cola cordifolia
Triplochiton scleroxylon

In the transition belt to Savannah-Woodland the following trees are common:

Afzelia africana
Anogeissus schimperi
Dialium guineense
Drypetes vignei
Millettia stapfiana

In 1935 C.Vigne, Silviculturist, recorded the following tree species in patches of relic High Forest:

Albizzia gummifera
A. zygia
Alstonia boonei
Antiaris africana
Antrocaryon micraster
Bosquiea angolensis
Ceiba pentandra
Celtis zenkeri
Chlorophora excelsa
Chrysophyllum albidum
Cola cordifolia
Entandrophragma angolense
Holarrhena wulfsbergii
Khaya grandifoliola
Newbouldia laevis
Omphalocarpum sp.
Piptadenia africana
Pterygota macrocarpa
Ricinodendron africanum
Sterculia elegantiflora
S. setigera
Terminalia ivorensis
T. superba
Turraeanthus africana
Triplochiton scleroxylon

Abandoned rice farm. Raphia vinifera.

RICE FARMS.

Rice (Oryza sativa L.) farms are usually created in areas occupied by the Ancistrophyllum-Calamus-Raphia Associes because of the wet soil conditions required by this crop. The most frequently chosen areas are the seasonal swamps. In making a rice farm, the woody vegetation is usually felled, except for any large trees, but the raphia palms are left standing. These are killed when the felling debris is burnt. The rice is grown pure and only one crop is harvested. The vegetation then returns to the Ancistrophyllum-Calamus-Raphia Associes in due course, but with a lower stocking of tree species.

HUNTING.

Hunting within the High Forest Zone has had no effect upon the general vegetation. But it is a different matter where the High Forest marches with the Savannah-Woodland. This will be described later, but suffice it to mention here that grass fires from the Savannah-Woodland (some of these are the result of farming) have caused the northern margin of the High Forest to recede. The process has been one of nibbling, for any one fire, no matter its frontage, does not penetrate into the closed High Forest for any great depth. In the initial attack, most of the herbaceous plants and shrubs are killed, but only some of the fire-vulnerable trees. Further damage is done in successive attacks - usually not more frequent than once a year, in the dry season - and the result is a ground flora of grasses and a woody vegetation of an open nature, composed of Savannah-Woodland species, with here and there relics of the former forest growing in the presence of telluric water.

The southern edge of the Moist Semi-Deciduous Forest has suffered little damage through fires from the adjacent Coastal Scrub and Grassland. This is probably on account of the greater humidity, because this forest is near the sea. Also, situated where it is, the harmattan has little effect on it.

WARS.

The existence of fairly large areas of Old Secondary Forest has led the writer to suppose that these are connected in some way with warfare. One such case is the Numia F.R. in southern Ashanti where the broken upper canopy and floristic composition show the vegetation to be Old Secondary Forest. Yet contiguous with it is the Onuem-Nyamibe Shelterbelt F.R. containing normal High Forest. It is known that the area now occupied by the Numia F.R. lay in the path of the Ashantis as they forayed to

the south. Histories tell of the large numbers of people who took part in these wars, and so it seems reasonable to expect that their encampments resulted in forest destruction. Also, towns and villages were razed to the ground - an easy matter considering the flimsy structures - and the new towns were built sometimes on different sites. In 1817, Bowdich (6) in describing an area which is apparently some 20 miles north of Cape Coast and therefore lying within what is still the High Forest Zone, said "....forest with large areas of the sites of large Fantee towns destroyed by the Ashantis".

Another case is the western part of the Mpameso F.R. in N.W. Ashanti. The present crop warrants it being termed "Disturbed Forest". There is a preponderance of Funtumia elastica in the lower storey, and the upper storey is broken and uneven. The only big trees are Bombax buonopozense, Ceiba pentandra and Entandrophragma utile. No useful information has been obtained about the history of this area, but it is suggested that although sparsely populated now (1952), it was once an inhabited area.

INHABITED AREAS.

The land in and around towns has usually been subjected to repeated farming until the soil has been exhausted. The vegetation has deteriorated to a scrub as already described for farmed land. Within the environs of the towns it is usual to find that the scrub has been kept in check by repeated cuttings from the sanitary squads. Often it is eradicated and is succeeded by a grass cover.

Amongst the species to be found in this vegetation are:

Herbaceous Plants

Aspilia latifolia	Oplismenus sp.
Axonopus compressus	Paspalum conjugatum
Hibiscus spp.	Sporabolus sp.

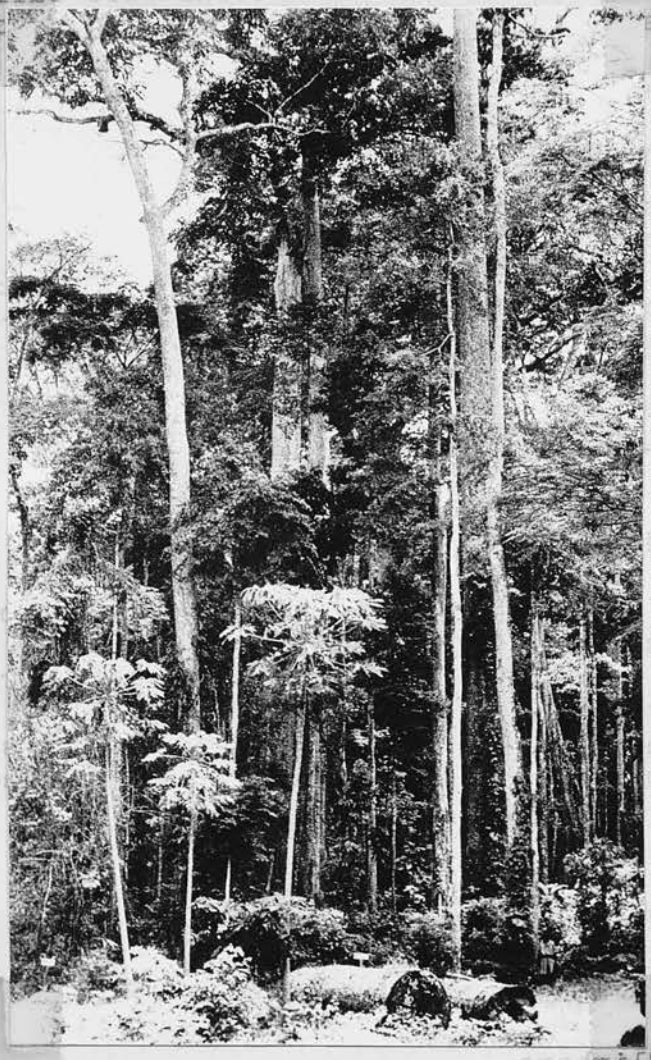
Climbers

Bandeiraea simplicifolia	Clerodendrum spp.
Cardiospermum grandiflorum	Combretum spp.

Shrubs

Alchornea cordifolia	Mallotus oppositifolius
Baphia nitida	Mussaenda erythrophylla
Brillantaisia spp.	Rauvolfia vomitora
Cassia mimosoides	Sida carpinifolia
Hoslundia opposita	Triumfetta cordifolia
Leea guineensis	

Apart from the relic trees - often Bombax, Ceiba and



Felling gap in High Forest.

Chlorophora - Canthium glabriflorum and Morinda lucida are particularly common, and also Spathodea campanulata in the Moist Semi-Deciduous Forest.

TIMBER EXPLOITATION.

Up to the present (1952), timber exploitation has been in the nature of selective fellings. As a result, large areas have been worked over in order to obtain well shaped, large girthed logs of a few species. For about the first 50 years of the timber industry (up to the Second World War) very few species were exploited. These were mainly mahogany and so-called mahoganies. In fact, most of the timber came from the genera Entandrophragma (now known as West African Cedar but previously often called some type of mahogany) and Khaya (West African Mahogany). Small quantities of other trees were also exploited, such as Guarea, Lovoa, Mimusops, and Nauclea (Sarcocephalus). Only big trees were taken, often with a girth of 15 feet or more at the convergence of the buttress roots. This resulted in a "creaming" of the exploitation areas, for even in the most productive forest it was unusual to obtain one exploitable tree on less than 10 acres because of the high quality standards demanded.

A change began to take place during the war when more species were taken by the timber merchants. A noticeable addition was the white, soft wood, Triplochiton scleroxylon. Even now there is no real demand for more than about a dozen species.

Timber exploitation has resulted in the removal of a large number of trees, but it must be remembered that the untouched, tropical forest is not normal in its representation of age classes. There is usually a preponderence of the older classes in any species, particularly of the trees of the upper and emergent canopies. It is from those trees that the timber merchants have obtained their yield. Thus, by confining exploitation to a few species in the upper age classes, little actual harm has been done to the natural forest.

On the other hand, timber exploitation has caused a certain amount of destruction to younger trees and seedlings of present day economic species through felling damage and the making of numerous extraction tracks in the forest. Also, to a lesser extent im making camp clearings. Exploitation damage does not result in a destruction of forest cover, but the regeneration which follows is made up largely of quick growing light demanders. This results in Secondary Forest, particularly lacking in Entandrophragma and Khaya species. This succession occupies seral stages similar to those already described for Secondary Forest and for abandoned food farms. The degree of similarity

Diamond winning in the Neung F.R.

Manganese mine. Nsuta.

depends on the size of the gaps and on the period during which the extraction tracks and camps have been used.

Timber exploitation, in itself, has caused little damage to the High Forest of the Gold Coast. But much destruction has been brought about by the farming which has followed closely on timber exploitation. The farmers take the opportunity of timber contractors' roads opening up new areas. In some localities, a state of affairs now exists where the farmers are felling and burning areas within or beyond the timber concessionaire's current felling coupe. In farm clearing and burning, valuable trees, both mature and immature, are destroyed, and so are lost to the concessionaire. The result is large scale destruction of good forest.

MINING.

Four forms of mining occur in the Gold Coast - gold, manganese, diamonds and bauxite. As a result of these activities, areas of concentrated population have developed. This is only partly true for diamond mining, for small workings may be exploited by individuals or small groups of people.

Diamond winning in the Gold Coast necessitates digging into the sub-soil. The valuable top soil is thus covered by the nutrient lacking spoil. Digging severs tree roots, and some of the trees fall over readily in storms. The ground is much broken up with pits, trenches and spoil heaps. On the latter there may be a covering of grasses. The dug up soil and the fallen trees and the few which are left standing give the area a derelict appearance. The ecology of such an area has not been studied in detail.

In general, three seral units may be observed around mining areas which have a settled population. In the immediate vicinity of the residential and works areas, the vegetation is a deflected sere or plagiosere, i.e. mainly a grass cover brought about by repeated cutting in the interests of sanitation. There may be a solitary relic tree or two. Surrounding this is a plagiosere of scrub, and beyond this is Secondary Forest.

The following refers to the gold mining area in the vicinity of Tarkwa. The grass plagiosere is evident in and around the residential and works areas. The scrub plagiosere has developed because of the requirements of food, fuel and mining timbers. The adjacent forest provided firewood and timber for the new mine, and clearings in it allowed farms to be made. The first seral stage which took place in this disturbed forest was the formation of a Musanga Consocies. This was observed by Thompson (43) in 1908 who stated that the hillsides in the mining areas were covered with Musanga. The natural succession was stopped because

these Musanga areas were re-visited after a relatively short period for farming or for fuelwood. As the distance of the true high forest receded from the mining centre, so were the first exploited areas cut over more thoroughly. The intensive farming and the virtual clearfelling for fuel and timber caused the high forest to disappear from a circular belt outside the grass plagiosere. In this present day scrub plagiosere, hardly a tree is to be seen. The scrub forms a closed canopy of about 15 feet high. Some of the species comprising it are:

Alchornea cordifolia
Anthocleista nobilis
Canthium glabriflorum
Combretum tarqueense (a)
Elaeis guineensis
Ficus spp.
Harrungana madagascariensis
Macaranga spp.
Mussaenda chippii
Randia spp.
Raphia vinifera
Spondianthus preussii
Vernonia conferta

(a) climber.

Anthocleista, Canthium, Vernonia and the two palms , Elaeis and Raphia usually emerge above the scrub layer.

The third sere extends around these two plagioseres. It is where incursions have been made into the forest for mining timbers, but where large scale fellings, either for firewood or for farms, have not been made. There the vegetation is a patchwork of untouched forest and Secondary Forest in various stages of succession.

Devastation of vegetation. Gold mine. Obuasi.

III. THE SAVANNAH-WOODLAND.

The Savannah-Woodland extends over the area north of the High Forest and beyond it to the south-east. Most of the area lies within the "one peak" rainfall zone, where the peak is in August-September. Although the precipitation is seldom less than 40 inches a year, and may reach 50 inches, it is the intense dry season from December to April which is a limiting factor on the vegetation. During that period, the noon relative humidity is extremely low. Also the soil is very hard during the dry season. The actual rainfall is not a true indication of the availability of water to the plants. At the beginning of the rainy season, much of the rain runs off the hard, baked soil and is lost to the vegetation.

This formation is typically composed of short statured, much branched trees, often less than 50 feet high, usually not forming a closed canopy and frequently widely spaced. Many of the species are fire resistant or fire hardy and have thick bark. The shoots of seedlings and saplings may be burnt back annually for a few years and only succeed when the root system is sufficiently large to throw up a vigorous shoot. A characteristic feature is the ground flora which is a more or less continuous layer of grass. Some of these grasses attain a height of about 8 feet.

Although some of the vegetation in this formation may be described as a Climatic Climax, a great deal of it is a Fire Climax (a form of Biotic Climax). What the original vegetation was like is subject to much speculation. Grass buring, mainly for hunting purposes, has taken place over most of this area for centuries. Richards (35) states "Grass burning is a practice so widespread and so ancient in West Africa (it was recorded at the time of Hanno's voyage, before 480 B.C.)...." Aubréville (1) describing the forest types of French West Africa states "It is wrong to consider that this type has a climatic origin. In fact, all this zone was covered, at one time, by open tropical forest, with a shrubby undergrowth and with scattered grassy areas. This forest differed from the tropical closed forest in appearance, by the floristic composition and by the light requirements of the species, although some of the more xerophilous species of the closed forest emigrated into the open tropical forest by a transition zone or by way of fringing forest. The bush fires have acted as a true climax factor and under their influence the grasses have developed considerably to the detriment of the former woodland." It would be interesting to know the species which Aubréville thinks comprised this former forest and why they should have had different light requirements from the adjacent closed High Forest trees.

Savannah-Woodland.

Foreground burnt, background unburnt.

Whatever the former crop may have been, it is beyond doubt that much of the present vegetation is not of recent origin and that the dominating factor controlling it is fire.

It is sometimes held that the outliers of High Forest occurring in the southern part of the Savannah-Woodland are indications of the former crop covering these areas. However, these outliers of a higher formation are Riverain (Fringing) Forest or groups of High Forest occurring in the presence of telluric water, combined with good drainage.

Fires in the Savannah-Woodland are made by man for three main reasons - (a) farming (b) hunting (c) fun. For these three forms of incendiarism, the dead grass during the dry season forms an inflammable medium. Fires may spread from new farms while the felling debris is being burnt, or from old farms if grain stalks are burnt after harvesting. Pasture areas are burnt in order to encourage the growth of the new grass. Fires for hunting are the most widespread of all. They are made so that the hunters can see the animals. Some of the grass fires owe their origin to natives who start them just because they like to see a fire.

An early fire, i.e. one at the beginning of the dry season, causes less damage than a late fire, i.e. one towards the end of the dry season. The latter creates a more intensive heat and is usually more complete because of the drier, more inflammable nature of the grass. It is easy to understand that late burning causes considerably more damage to the vegetation than early burning. This experience finds its application in controlled early burning in Forest Reserves in order to protect the trees against an accidental or wilful, late and damaging fire.

There is little doubt that the Savannah-Woodland has encroached into the High Forest Zone. No real ecotone exists between these two formations, for what was the ecotone has disappeared as such, and is now what may aptly be termed the Derived Savannah-Woodland. This former ecotone (sometimes vaguely referred to as the Transition Belt) was a tension zone, and although high forest, it was more vulnerable to fire damage because atmospheric conditions within it were fairly dry during the harmattan period. It had no protection on the north from the desiccating effects of this wind. Although belonging to the Antiaris-Chlorophora Association, it is likely to have been more open and to have had patches of Savannah-Woodland in it where edaphic conditions were unsuitable for high forest. The reverse is now the case, and the area is at present occupied by Savannah-Woodland with an occasional relic high forest tree, or riverain forest or patches of high forest on suitable sites. For practical purposes, it is being included in the Savannah-Woodland Formation in this study.

Busse (7), writing in 1908, considered that the development of savannah-woodland in Southern Togoland (then German Togo) took place in modern times but that it then represented a genuine savannah area both in climatic conditions and in its vegetation. Busse's views seem to be based on a journey from Lome to Atakpame, when he noticed forest on the hills and where there was available ground moisture. This German ecologist also states (7) "....the south of Togoland must have been covered by dense, lush Rain Forest as is still found in some parts of neighbouring countries of the same latitude. Southern Togoland nowadays represents one of the savannah breaches which have forced their way, in the course of centuries, into the former West African Coastal Belt, reaching from Sierra Leone to the Equator. This breach was made by man." As is described later, it is not considered that there was such a continuous Rain Forest Belt.

THE GUINEA SAVANNAH-WOODLAND.

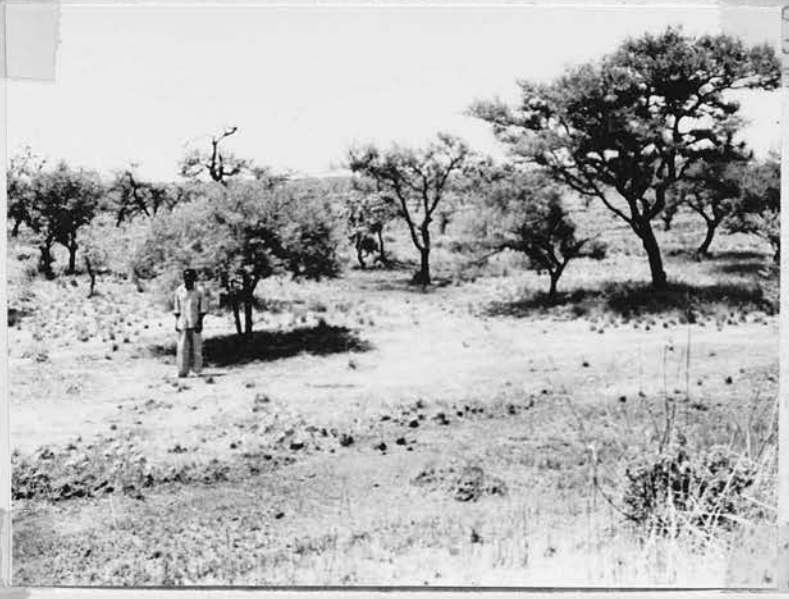
The Savannah-Woodland is represented by one main formation - the Guinea Savannah-Woodland, which occupies a large area of West Africa. Within it are various associations and seral communities. The ecology of this zone is much more varied than that of the High Forest. It would require an intensive study on its own to justify a proper classification into ecological units. The following observations are therefore somewhat generalised.

The concept of the ecological catena is applicable to this formation, but not to the High Forest. At any rate, not vegetational catena has revealed itself in High Forest to the writer. The combination of topography and drainage has an important influence on the vegetation in the Savannah-Woodland. It should be remembered that soil erosion is more prevalent in this zone than in the High Forest because the ground is more easily exposed. This is on account of the open nature of the tree crop and the annual or periodic burning of the ground flora.

An enumeration survey summary of the Gambaga Scarp (East) F.R. is given in Appendix 12. About 90 species of trees 1 foot or more in girth B.H. are recorded on 444 acres. Of the 24,210 trees counted (almost 55 per acre), 90% are in the 1-3 feet girth class, 9% in the 3-5 feet girth class and only 1% over 5 feet girth B.H. This enumeration represents a complete catena from the upper slopes right down to the river. Parts of the area have been farmed over, and almost all of it, except perhaps some of the wetter areas, has been subjected to grass burning.

Savannah-Woodland.

Treeless area over flat bedded rocks.



Savannah-Woodland. Acacia mellifera growing on an area of impeded drainage.

THE VEGETATION CATENA.

A typical catena may consist of (a) upper slopes (b) middle slopes (c) swamps (d) water courses.

Upper Slopes.

The tree crop is variable and is correlated with the condition of the soil. Often the soil is poor through repeated cultivation and erosion. Acacia dudgeonii and A. seyal are typical indicators of such soils. Under better conditions, Isoberlinia dalzieli and I. doka grow semi-gregariously.

Middle Slopes.

These are usually reasonably fertile and well drained, and are favourite farming areas. Acacia spp. are infrequent. The common trees are:

Afrormosia laxiflora	Hannoa undulata
Burkea africana	Hymenocardia acida
Butyrospermum parkii	Lophira alata (a)
Daniellia oliveri (a)	Stereospermum kunthianum
Detarium senegalense	Vitex cuneata

(a) more so in the South.

Swamps.

Swamps are of two main types - areas of impeded drainage with alternating wet and dry ground conditions, and permanent swamps which may dry out partially during the dry season but which are often near water courses.

Large areas of impeded drainage are encountered in the Savannah-Woodland. They are usually quite level and present a characteristic appearance. The trees are few, the grasses are usually short and tufted and may not form a continuous ground cover. In fact, stretches af bare, dark coloured soil and exposed flat bedded rocks are not uncommon. Crossopteryx febrifuga is often an indicator where the drainage is somewhat impeded without creating a swamp. With a worsening of conditions i.e where seasonal flooding by run-off, but not river overflow takes place, the usual tree species are:

Acacia mellifera	Pseudocedrela kotschyi
Gardenia spp.	Terminalia macroptera.

These areas are often found on the bottom slopes, but it is not unusual to encounter them on small plateaux where flat bedded rocks are at or near the surface.

Dichrostachys glomerata.

Anogeissus-Lannea Associes.

Anogeissus Consocies.

Swamps associated with river flood water often consist of an associes of Mitragyna inermis and Crataeva adansonii, with little or no ground flora but clumps of the shrub Dichrostachys glomerata.

Two edaphic communities not occurring in a typical catena but found in the Savannah-Woodland are the Phoenix reclinata Consocies (e.g. east of Kpandu and elsewhere) in marshes, and the Borassus aethiopum Consocies found particularly in the southern part of the Guinea Savannah-Woodland (e.g. Afram Plains) and usually around the margins of damp depressions. Terminalia spp. are often to be found in the vicinity.

Water Courses.

The natural vegetation associated with water courses may be divided into two types - (a) Riverain (b) Riparian.

Riverain Woodland.

This is the woodland in the neighbourhood of a river, i.e. near to but away from the actual river bank. Ground water is available throughout the year, or at any rate, for most of it. The tree crop differs slightly in physiognomy from the Savannah-Woodland in being taller; the stocking is often denser. The tree canopy may be closed but is usually not so dense as to prevent a grass ground flora. The crop is represented by an Anogeissus-Lannea Associes, although Anogeissus schimperi is not uncommon as a consocies. Afzelia africana is often a constituent of this Riverain Woodland.

Riparian Woodland.

This name is applied to the vegetation of the river bank. Often it falls into two subclasses - that occurring on the levee, and the riverside plants.The soil is alluvial. The levee is the top of the river bank and is a natural embankment. It is usually less than 200 feet wide.

Levee.

The vegetation may be represented by an Acacia-Celtis-Khaya Associes. Because oftthe suitable soil and the presence of ground water, growing conditions are favourable. There, Khaya senegalensis may attain a girth B.H. of 9 feet, or slightly more. The principal species are:

Acacia campylacantha
A. rehmanniana
Afzelia africana
Celtis integrifolia
Garcinia baikeana
Kigelia aethiopica
Oncoba spinosa
Pterocarpus erinaceus
ZiZyphus jujuba

Riverside vegetation in the Savannah-Woodland.

Butyrospermum-Parkia-Tamarindus Associes.
Icacina senegalensis in the foreground.

Riverside.

By the riversides is a vegetation which may include some of the species listed above, if there is a bank due to a levee, but embraces more shrubs than trees. During the rainy season, the rising waters may partially submerge some of the plants. Typical species are:

Berlinia heudelotiana
Cola laurifolia
Cynometra vogelii
Feretia canthioides
Mimosa asperata
Paullinia pinnata
Quisqualis indica
Sesbania sp.
Vitex chrysocarpa

SUCCESSION.

Where fire can be kept out, an improvement can be seen in the vegetation of the Guinea Savannah-Woodland. In the north, this results in a denser stocking and apparently faster height and girth growth. In the south, and especially when adjacent to the High Forest Zone, the first seral stage after fire protection is the formation of closed woodland. The next seral stage is the invasion of this woodland by a few High Forest trees and a diminution of the grass flora. Detailed observations have not been made of later stages, but provided that complete fire protection is possible, it is reasonable to expect such an area to return to High Forest in the course of time. The process is likely to be a long one.

Complete fire protection, except in a few small areas, is but a pious hope. An instance has been seen in the Afram Plains, at Berem, where an area of Derived Savannah-Woodland, near High Forest, has reached the second seral stage of succession to High Forest. Fire protection has been brought about by the spread of yam farms which now form a barrier between the grass fires and the woodland to the south.

BIOTIC SERAL COMMUNITIES.

Man.

There are three conspicuous seral communities in the Guinea Savannah-Woodland which are due to intensive attention by man.

(i) Butyrospermum-Parkia-Tamarindus Associes.

In the extreme north of the Gold Coast there is settled farming, and so agricultural practice is intensive. On such arable land the only trees left are those which are of direct use to man. Often these are only Butyrospermum parkii, Parkia filicoidea and Tamarindus indica - all of which provide food for the people. Another tree which may occuris Acacia albida, which provides cattle fodder. Quite frequently it is found in

Closed Woodland developing through to exclusion of fire.

Unprotected Area. Protected Area. Navrongo.

Sheet erosion. Paga.

small, pure groups.

To the north-east, the tree vegetation is very sparse. This is due to a density of population of over 100 persons to the square mile, and to intensive farming.

(ii) Bauhinea-Combretum-Piliostigma Associes.

On worked out land the vegetation consists of a short scrub growth of Bauhinea rufescens, Combretum spp. and Piliostigma thonningii, Anona senegalensis and the shrub Icacina senegalensis. Not only has there been soil deterioration in such places, but sheet erosion has also taken place. In an extreme case, the ground may be almost devoid of vegetation.

Fires, grazing and repeated firewood collecting keep down the height of this scrub. At Navrongo, an experimental area in this form of scrub is being fully protected against fire, grazing and cutting. Already it is showing marked increase in height growth and a greater density of stocking in contrast to the adjacent unprotected area.

(iii) Adansonia-Tamarindus Associes.

In the north, the sites of old habitations are marked by the presence of Adansonia digitata and Tamarindus indica. Often these sites are slightly elevated. Other vegetation is sparse and the ground is usually badly eroded.

Termites.

A Balanites-Diospyros Associes is to be found on old termite mounds. The dominant species are Balanites aegyptiaca and Diospyros mespiliformis, with a dense thicket below, in which Fluggea virosa and Grewia spp. are commonly present.

DERIVED SAVANNAH-WOODLAND.

Evidence of this degradation from High Forest by fire is to be seen at various localities along the northern limits of the Antiaris-Chlorophora Association. The vegetation is similar to the adjacent Guinea Savannah-Woodland but is often denser in stocking. Occasionally relics of High Forest trees occur, such as Antiaris africana, Chlorophora excelsa and Khaya grandifoliola. The more common species are:

Riverain Forest. River Afram.

Afrormosia laxiflora	Malacantha alnifolia
Afzelia africana	Nauclea latifolia
Anogeissus schimperi	Parkia filicoidea
Butyrospermum parkii	Schrebera
Daniellia oliveri	Sterculia setigera
Detarium senegalense	Terminalia glaucescens
Hannoa undulata	T. macroptera
Hymenocardia acida	Uapaca guineense
Lophira alata	U. togoensis

Anogeissus schimperi is a coloniser. Both silviculturally and in habit it is not unlike Betula alba L., the birch of the North Temperate Zone. It is dominant in the first seral stage of the new Fire Climax crop, and is often found growing as a consocies at first. Its light foliage allows other species to regenerate below it.

Togoland would provide an interesting study of the relationship between High Forest, Savannah-Woodland and Derived Savannah-Woodland, for all these types of vegetation occur within a convenient ecological area. Also, on some of the hilltops the vegetation is almost entirely grass. It is suggested that some of these hilltops were inhabited areas in the days when they were a refuge from slave raiders. The clearings made for dwellings and farms have resulted in most or all of the soil being washed away. Many of these hilltops sustain little more than a grass vegetation.

RIVERAIN FOREST AND FOREST OUTLIERS.

In the southern part of the Guinea Savannah-Woodland are belts and patches of a High Forest formation. Those that are associated with water courses are known as Riverain Forest - synonyms (13) Fringing Forest, Gallery Forest, Riparian Forest - and those away from water courses as Forest Outliers. They are post-climaxes in an area where, although the vegetation is now a Fire Climax, it is presumed that its original form was composed of mictia of high forest, closed woodland and savannah-woodland, determined largely by the soil/water conditions. The Riverain Forest and Forest Outliers owe their existence to the presence of telluric water and good drainage. Riverain Forest is a narrow belt on both sides of a water course and Forest Outliers are usually on rising ground.

The vegetation in this formation is similar to that along the northern edge of the Antiaris-Chlorophora Association, but the maximum height growth is usually less. There are typically two tree storeys, the upper being open and uneven, and the lower more or less closed; also a shrub layer and a herbaceous layer

sometimes with grasses along the margins. The more common constituents are:

Upper Storey.

Afzelia africana	Cistanthera papaverifera
Albizzia gummifera	Cola cordifolia
Antiaris africana	Erythrophleum guineense
Antrocaryon micraster	Pterygota macrocarpa
Bombax buonopozense	Ricinodendron africanum
Ceiba pentandra	Terminalia superba
Chlorophora excelsa	Triplochiton scleroxylon

Lower Storey.

Bosquiea angolensis	Napoleona parviflora
Caloncoba dusenii	Sterculia setigera
Celtis scotellioides	Teclea grandifoliola
Lonchocarpus sericeus	Trichilia prieuriana
Monodora myristica	

Shrubs.

Leea guineensis	Mussaenda elegans
Mallotus oppositifolius	Triumfetta rhomboidea

GRASSES OF THE GUINEA SAVANNAH-WOODLAND.

The more common grasses in the Guinea Savannah-Woodland may be summarised as follows: (18)

Sequence after Farming.

The sequence depends to a large extent on the soil fertility and this is conditioned by the pressure of population.

A. Granite Areas of the North.

(a) 1st. seral stage. Many of the pioneers are annuals. The more important ones are:

Andropogon spp.	Hyparrhenia spp.
Brachiaria brevis	Pennisetum pedicellatum
Diditaria gayana	P. polystachyon
Eleusine indica	P. subangustum
Eragrostis aspera	Rottboellia spp.
E. albida	Schizachyrium spp.
Hackelochoa spp.	

(b) 2nd. seral stage. In a year or two many of the pioneers are ousted from the succession by coarse perennials. The more common ones are:

Andropogon gayanus	Elionurus pobeguinii
A. pseudoafricus	Hyparrhenia spp.
A. schirensis	Schizachyrium spp.

(c) 3rd. seral stage. If the land is rested long enough, the grasses listed below are the usual species found. These constitute the grass layer over large areas of the Northern Territories:

Andropogon spp.	Hyparrhenia diplandra
Chasmopodium caudatum	H. rufa
Cymbopogon giganteus	H. subplumosa
Diectonis fastigiata	Panicum spp.
Eragrostis spp.	Schizachyrium spp.

(d) Seral community on poor areas. This is the seral stage found on very heavily farmed land or on areas of low fertility. The grass cover is scantier and the species are short and wiry. As retrogression has gone so far, it takes a long time, if ever, for this stage to be replaced by the clumped, perennial grasses of the Savannah-Woodland. (It is interesting to note that Agriculturists are trying to hasten the succession by excluding fire from such short, wiry grassed areas.) The more common species are:

Andropogon spp.	Hyparrhenia spp.
Aristida kerstingii	Londetia spp.
Ctenium elegans	Monocymbium ceresiiforme
Cymbopogon proximus	Schizachyrium exile
Elionurus hirtifolius	Schoenefeldia gracilis

B. Southern Savannah-Woodland.

This is roughly the area from about Tamale southwards to the Derived Savannah-Woodland. The most important grass which appears after farming is lalang - Imperata sp. (I. cylindrica?) This may dominate large areas for a long time, but is eventually supplanted by the normal Andropogon-Hyparrhenia mixture if left undisturbed. Around Tamale, Cenebrus biflorus is commonly fostered by farming.

C. Derived Savannah-Woodland.

In the vicinity of Ejura the common grasses on abandoned farms are:

Andropogon tectorum	Setaria sphacelata
Panicum maximum	Sorghum arundinaceum.

D. Unfarmed Areas.

Where drainage conditions are moderately good, the grass communities in the Savannah-Woodland are largely those listed at A (c) above. There are, of course, local variations within these communities.

In wet areas the typical grasses are species of:

Andropogon
Bothriochloa
Chasmopodium
Hyparrhenia
Londelia
Paspalum
Panicum
Setaria
Vetiveria

Where wetter conditions obtain, the grasses include:

Acroceras zizanioides
Brachiaria stigmatista
Erochloa spp.
Leersia hexandra
Oryza barthii
Rhytachne spp.
Setaria spp.

IV. THE COASTAL SCRUB AND GRASSLAND.

This coastal zone extends as a strip from near Takoradi and widens towards the east. It coincides with an area of low rainfall, which is influenced by the line of the coast running more or less in the same direction as the S.W. Monsoon. Although the dry strip experiences a "two peak" rainfall, its average annual precipitation isaabout 33 inches. In the neighbourhood of Accra it may be not more than 25 inches.

The present day vegetation falls into two types. From Weija (near Accra) westwards, it is a dense scrub, but this gives place to grass where the drainage is poor. To the east, the greater part of the area is grassland, with very few trees. However, patches of scrub occur in it.

It is possible that the vegetation which occupied parts of the coastal plain was of a higher order than it is today. It may have been a more open form of the Antiaris-Chlorophora Association, with a dense layer of shrubs and stragglers, except where grasses now predominate. The grassland may have contained clumps of trees on the better drained soils. Evidence that trees did grow on the Accra Plains is obtained from the following folk-lore recorded by Irvine (22):

"Some time in the second half of the eighteenth century a Fante boat landed at Labadi....

"The canoe in which the Fantes came was like the present canoe but was smaller and had no sail. At that time the forest grew much closer to the sea and trees suitable for making canoes grew close to Labadi, so that they were able to make their own boats. But in the course of time the forest receded until today canoes are made as far off as Kibi and farther, and are brought down to the sea in lorries. When the forest had gone too far away for the Labadis to make their own canoes they took children's canoes to the bush as models for people to copy in making sea-going canoes for them. It was in this way that people remote from the sea learned to make these fine sea-boats."

If,there has been no change in the species used for canoe making, then the tree is Triplochiton scleroxylon.

COASTAL SCRUB.

The scrub is a dense tangle, seldom much more than about 15 feet high. Growing above it are isolated trees. Although the latter are High Forest species, they are usually much smaller

Coastal Scrub.

in stature in this zone. The shrubs and small trees are a mixture of High Forest and Savannah-Woodland species.

The principal constituents of this type are:

Trees.

Albizzia warneckii
A. zygia
Antiaris africana
Bombax buonopozense
Cistanthera papaverifera
Sterculia tragacantha

Small Trees, Shrubs and Lianes.

Acridocarpus longifolius
Baphia nitida
Cardiospermum grandiflorum
Carissa edulis
Cassipourea congensis
Chaetacme microcarpa
Christiana africana
Clausena anista
Clerodendrum scandens
Conopharyngia chippii
Desmodium lasiocarpum
Dialium guineense
Dichapetalum barteri
D. flexuosum
Dichrostachus glomerata
Diospyros mespiliformis
Ehretia cymosa
Elaeophorbia drupifera
Fagara xanthoxyloides
Grewia carpinifolia
Holarrhena wulfsbergii
Hoslundia opposita
Hymenostegia afzelii
Indigofera macrophylla
Jasminum dicholomum
Lantana camara (introduced)
Lecaniodiscus cupanioides
Malacantha alnifolia
Mallotus oppositifolius
Manilkara lacera
Mezoneurum benthamianum
Oncoba spinosa
Ouratea myrioneura
Paullinia pinnata
Pavetta mollis
Phyllanthus reticulatus
Picralima elliotii
Rhyncosia calycina
Rinorea spp.
Ruspolia hypocrateriformis
Spondias mombin
Strophanthus spp.
Synsepalum dulcificum
Trichilia prieuriana
Uvaria chamae
Vitex fosteri
V. grandifolia
Waltheria americana
Ximenia americana.

The present vegetation may be considered as the pre-climax of a climatic climax where the limiting factor is biotic. This zone has been heavily farmed in the past and is still farmed, but the soil conditions are so poor over most of the area that only cassava can be grown. Some corn and tiger nuts are also cultivated. In making a farm, the scrub is cut and burnt, but the fires are usually localised and are not sweeping. Thus it is not fire which is responsible for destroying the southern margin of the High Forest; the destruction has been due to farming. In this heavily farmed belt, isolated High Forest trees remain, and there has been a certain amount of invasion by shrubs from the scrub. The grass which appears after farming

In farmed areas the principal grasses are:

Dactylotaenium aegyptium	Heteropogon contortus
Digitaria horizontalis	Sporabolus sp.

SERAL COMMUNITIES.

The following seral communities are recognisable:

(a) Scrub. This is in patches and is similar to that found in the west.

(b) Savannah-Woodland. Various seral stages occur and the invasion is from the east. In the ecotone on the hills in the vicinity of the Volta River F.R. are Afzelia africana, Anogeissus schimperi, Cassia sieberiana and Stereospermum kunthianum. Nearby, on the northern road between Trom and Adukrom, Afzelia africana and Daniellia oliveri are associates. Near Kpong, a first seral stage is noticeable because of dense groups of young Anogeissus. South of this there is poor Savannah-Woodland, where Crossopteryx febrifuga is common.

(c) Termite mounds. Broken down termite mounds bear groups of vegetation which is largely scrub made up of:

Abutilon spp.	Fluggea virosa
Allophyllus warneckii	Grewia carpinifolia
Cassia mimosoides	

Cannavalia obtusifolia.

Phoenix reclinata growing on the dune.

V. MARITIME VEGETATION.

The maritime vegetation is classed as a single formation, even although the plants comprising it range from terrestial forms to arboreal plants of relatively short stature. It occurs as a strip along the coast which includes the lagoons. This strip is broken in places by rocky, rising land, such as at Accra.

The vegetation is an edaphick climax conditioned by maritime influences. Many of the plants are capable of living where the water table is high and the soil water brackish.

Three types are distinguished - Strand, Mangroves and Former Lagoons.

STRAND.

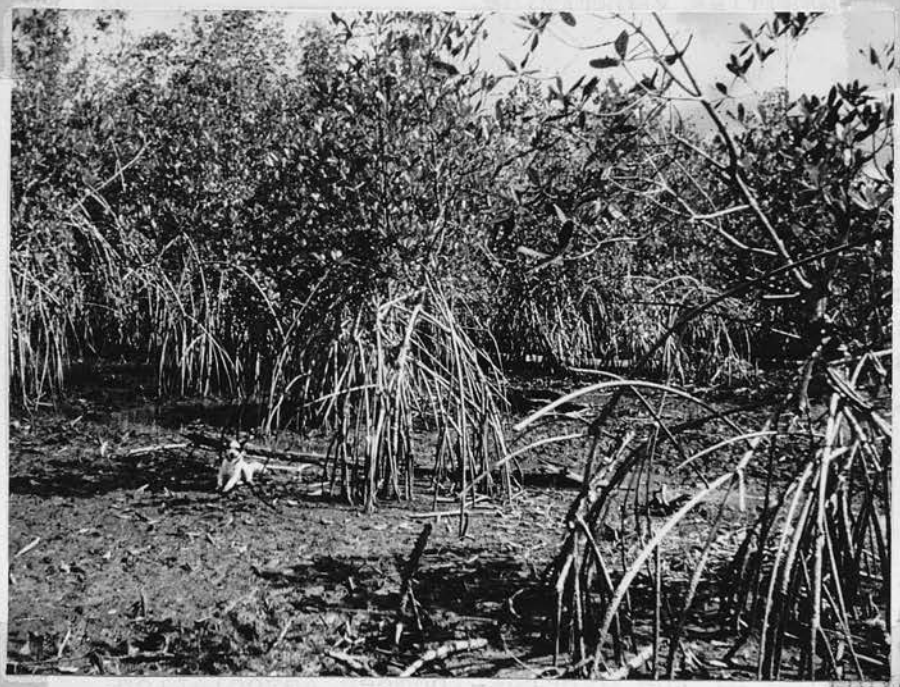
Strand vegetation is confined to the foreshore, above highwater mark. On the seaward side, the plants are herbaceous and rise only a few inches above the sand in which they grow. The vegetation is typified by the Cyperus-Ipomoea Association. The two creepers, Cannavalia obtusifolia and Ipomoea biloba, ramify through the Cyperus maritimus and Diodia vaginalis. Amongst these plants occurs the introduced Opuntia vulgaris.

On top of the dune the vegetation is likely to include the dwarf palm, Phoenix reclinata and the shrubs Baphia nitida, Eugenia owariensis, Grewia spp., Sophora occidentalis, Thespesia populnea (introduced) and Triumfetta rhomboidea.

Coconut plantations have been established along the dune at numerous places.

MANGROVES.

The mangrove vegetation is represented by the Avicennia-Laguncularia-Rhizophora Association, and it occurs in brackish water which is usually tidal. Because of the soft mud and the brackish water the mangroves have developed stilt roots and pneumatophores. Laguncularia racemosa and Rhizophora racemosa are small trees, usually less than 20 feet high. They grow on the seaward side of lagoons and in the tidal parts of creeks and rivers. Avicennia nitida is often not much more than a bush. It occurs to the landward side of the other two species, in mangrove swamps.



Mangrove swamp at low tide. Avicennia nitida.

Sites of former lagoons.

FORMER LAGOONS.

At various places behind the dune and below its level are flat areas. They are evidently former lagoons which have been sealed off from the sea. The soil is often black and powdery, and cakes when dry. Such areas may become swampy during the rains. The vegetation is a grassland, with mangroves in the permanently wet places and scrub on the mounds. The mangrove is Avicennia nitida. It may persist for a while where the soil is drying, but will disappear in time. The greater part of the vegetation is made up of the following herbaceous plants:

Cyperaceae.	Gramineae.
Cyperus maritimus	Panicum repens
	Paspalum vaginatum
	Setaria anceps
	Sporabolus virginicus

On the small mounds, where there is the chance of some drainiage, scrub is formed, containing Abutilon asiaticum, Celtis scotellioides, Grewia spp. and others.

A fairly large, flat area of what appears to be dried up lagoons occurs to the immediate north of Esiama. In it are islands of vegetation on slight rises, which in many cases are broken down termite mounds. Whether the termite mound has been the cause of the higher vegetation or not, was not obvious from the sites visited. The plants in these islands consist of:

Alchornea cordifolia	Elaeis guineensis
Aspilia latifolia	Raphia vinifera
Carapa procera	Sterculia tragacantha.

Tropical Shelterwood System. Natural regeneration Of Lophira procera at 3 years.

I N T R O D U C T I O N.

The choice of the High Forest trees dealt with in this section is my own and it has been made for various reasons. With a flora containing so many tree species, it is obvious that a work of this scope must be limited to a reasonable number. About 160 are described - some in greater detail than others. Those first selected are the present day economic trees. Others were chosen because of their importance ecologically. Some, at first glance, appear to be of little importance, but they may be trees which are commonly encountered in the High Forest. The odd one has crept in because of its similarity to a more important cousin. Finally, it may be said that the choice is that of a Forester who feels that these are the trees of the High Forest which comprise his principal working tools.

Data have been included which may be of some help in the not always easy matter of tree identification.

A great deal of work requires to be done on the silviculture of individual species. In the pages that follow an attempt has been made to compile the information that has already been ascertained by Gold Coast Foresters and to add the result of one's own observations, experiments and deductions. Particular research has been carried out on the seedling - a subject hitherto rather neglected in the Gold Coast, but which has assumed greater importance because of the recent introduction of experimental work in natural regeneration. The difficulty of identifying the seedling is made more difficult by not a few having leaves which bear scant or no resemblance to those of the more mature specimen.

Part of present silvicultural research is concerned with obtaining natural regeneration under a shelterwood, combined with the exploitation of the forest. This is known as the Tropical Shelterwood System - a technique adapted from that developed by the Nigerian Forest Department. The objects include speeding up the regeneration period and increasing the proportion of the economic and potentially economic trees in the new crop. The operations aim at encouraging the growth of the natural regeneration under a lightened canopy. This is achieved by cutting the lianes and so killing them, and removing the dense, heavy crowned, low branched trees in the lower storey in two successive annual operations by poisoning them with an aqueous solution of sodium arsenite. The effect is to "raise the canopy" and allow in more light, but not too much, so that the fast growing, light demanding weeds are kept down to the minimum.

Annual ground cleanings to free the desirable species take place from the second to the fifth years, by which time it is hoped that the regeneration period will have been successful, and exploitation of the mother trees can take place.

Artificial regeneration is a contingency which must be catered for. Three principal forms occur in the Gold Coast High Forest. Plantations, in the strict sense of the term, are not often created, except with exotics grown for a particular use, such as firewood. On the other hand, taungya plantations are common practice. In their initial stage they are a combination of agriculture and forestry. The farmers prepare the area, which is usually poor forest, by felling and burning all the vegetation except the marked standards. This takes place after any possible exploitation. The farmers grow and harvest their food crops for a period of about 3 years, and at the same time they tend the young trees planted by the Forestry Department. The choice of tree species must be made carefully, for this a knowledge of the silviculture of the individual is necessary.

Another form of artificial regeneration is the planting of young trees of selected species in High Forest. This improvement planting may occur where natural regeneration methods have failed, or where the forest may have lost its structure and so be deemed an unlikely subject for natural regeneration techniques.

Where there is the necessity of artificial regeneration, nursery practice is of paramount importance. Even in the best of conditions it is expensive, but costs rise rapidly where the practice is at fault. In the high forest it has been found that a nursery should be sited on the well drained middle slopes of the soil catena and not in the sandy valley bottoms where the soil is lacking in nutrients and becomes exhausted quickly. (An exception is the greenstones of the Upper Birrimian series, where almost any site on the catena will do). On a good site, soil fertility can be maintained reasonably well by proper cultivation, which includes digging, the application of compost and the use of fallows. It is important that the site is free of from tree roots so that there shall be no competition with the seedlings for soil moisture. Watering will be required for the younger seedlings during dry spells.

It has been found advantageous to cover germination and transplant beds with split raphia mats about 6 feet off the ground. These are rolled up in the dull or rainy weather. Not only do they induce better conditions for the growth of the seedlings, but they tend to reduce the incidence of insect

attacks such as are found on certain seedlings and saplings growing in exposed conditions, e.g. the gall of Chlorophora and the shoot borer of Khaya.

In general, the viability of the seeds of High Forest species is of short duration, and so it is best to sow the mature seeds as soon as possible after collection. Transfer from the germination bed to the transplant bed is made when the seedlings are big enough to be moved - often about 3 months. At the end of about 15-18 months from germination, i.e. during their second rainy season, most species are big enough for planting out. This is either as a stripped plant, when all the leaves but a few at the tip of the shoot are removed and the root trimmed, or as a stumped plant, when the shoot is cut back to about 2 to 3 inches above the ground, and the root pruned to about 6 inches below the collar. The method varies with the species, although in some cases it is immaterial which is used. As a generalisation the Meliaceae do well when stripped and the Leguminosae are much better stumped.

By germination period is meant the time from sowing until the rate of germination (i.e. the number of seeds germinating per day) reaches its peak (19). Where the germination period is an extended one, then the time when germination begins and the period during which germination may be expected to continue has been given. Germination per cent is the ratio of the number of seedlings obtained from a parcel of seeds by the 30th day from the beginning of germination. Plant per cent is the ratio of the number of plants surviving at a stated period from a parcel of seeds. This may be after transplanting and so is a figure of more practical importance than germination per cent.

Height measurements of natural seedlings have been taken from the Indicator Plots set out in 1949 in the Silvicultural Research Centres where the Tropical Shelterwood System is undergoing trial.

Phenological data have been recorded for the High Forest as a whole. For a geographically scattered species the dates of the different phenomena do not vary so much as to be of practical importance. Even in the same locality there may be variations of time for a species. Sometimes this is influenced by edaphic conditions, but in other cases the factors causing this time variation are not known. The fruiting period has been taken for practical purposes as the time when ripe seeds are normally available. Thus the phenological data given here are for the species and not necessarily for the individual tree. Flowering and fruiting are annual for most species but individuals may miss a year. Where deciduousness is recorded it normally

applies to the trees above the pole stage. Seedlings, saplings and poles are often not deciduous although the more mature tree may be. The duration of deciduousness is usually shortened when the tree fails to produce flowers in any year.

Bark and slash characters can be useful diagnostic features, particularly in High Forest, where even if the individual crowns are discernible - and often they are not - they may be 100 feet or more above the observer. To be able to recognise the various slashes is much more convenient than trying to see details of leaves through binoculars or shooting down specimens. The picking up of fallen leaves from the forest floor is unwise unless as a means of verifying a separate diagnosis.

By slash is meant a sharp cut, diagonal for convenience, through the other and inner bark to the periphery of the sapwood. A particular character or combination of characters such as colour, texture, exudate, odour, and the presence or absence of ripple marks (usually caused by storeyed parenchyma) may provide an immediate identification. Some characters are exhibited throughout the family or genus, e.g. milky latex in the Apocynaceae and Sapotaceae, usually coloured latex in the Guttiferae, dark flecks in the inner bark of Celtis and ripple marks in Dialium. But a word of warning about the slash. It is usually abnormal in the sapling and young pole and in buttresses.

Vernacular names are, on the whole, surprisingly specific, but care should be exercised in accepting them. For example, Samanta (Twi) may refer to Bussea, Calpocalyx and Xylia - all trees with woody pods, and those of the last two being particularly alike.

No attempt has been made at artistry: the line drawings are diagrammatic to a certain extent. They and the photographs are my own and are of actual specimens.

Alphabetical sequence has been adopted for the families and for the genera and species within them. This arbitrary arrangement is for convenient reference.

ABBREVIATIONS OF NATIVE LANGUAGES & DIALECTS.

Ao	Aowin	F	Fanti
Ad	Adangwe	Nz	Nzima
Ash	Ashanti	S	Sefwi
Br	Brong	T	Twi
D	Denkyira	W	Wassaw
E	Ewe		

ANACARDIACEAE.

A family of trees and shrubs, with alternate, exstipulate, simple or compound leaves; the flowers are usually 5-merous. The fruit is often a drupe which is edible in some species.

This family contains two exotics which are important because of their fruits - Anacardium occidentale L. (cashew nut) and Mangifera indica L. (mango). Both are naturalised in the Gold Coast. The cashew nut is found in the open country to the east of Accra. The mango occurs almost wherever man has penetrated in the Gold Coast, even to the irrigated dry season gardens in the extreme north. It produces better fruit where it gets plenty sun and not too much rainfall.

The family is represented in the High Forest and Savannah-Woodland, but mainly as small trees, e.g. Haemotostaphis Hk.f., Pseudospondias Engl., Sclerocarya Hochst., Spondias L. and Trichoscytha Hk.f.

GENERA. 1. Antrocaryon Pierre. 2. Lannea A.Rich.

ANTROCARYON Pierre.

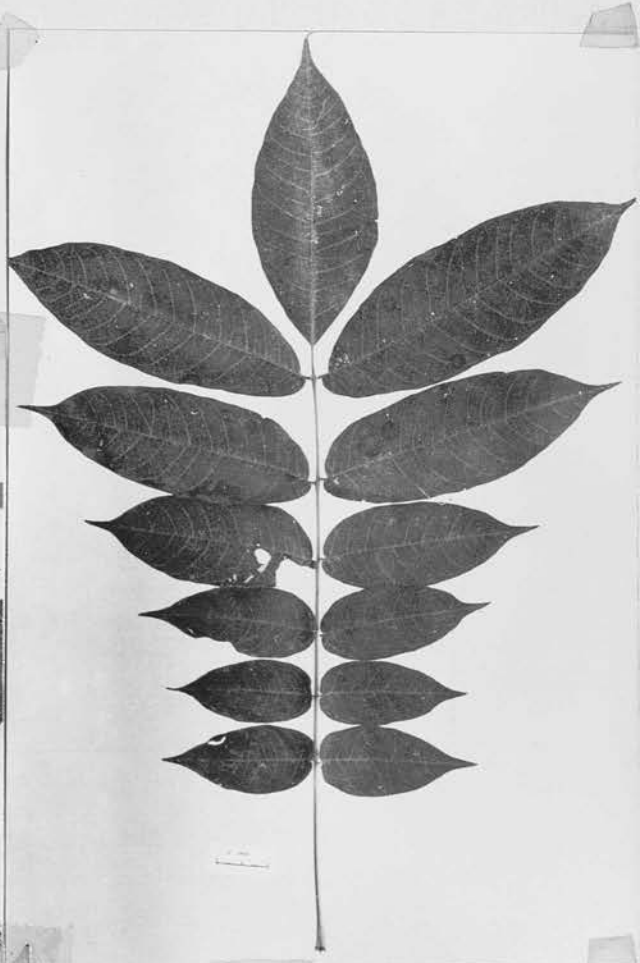
Antrocaryon micraster A.Chev.& Guill.

SYNONYM. A. polyneurum Mildbr.

VERNACULAR NAMES. Aprokuma (Ash) - a name also applied to Panda oleosa Pierre -. Etwi (S).

A fairly tall, straight tree with a cylindrical bole and no buttresses, but short root spurs occur, not higher than about 2 ft. above ground. The leaves barely overlap each other and are borne at the ends of the branches. This gives a characteristic appearance to the large, spreading crown when viewed from below. It calls to mind lace work. The tree may reach a height of 130 ft. or more, with a girth at breast height (4 ft.3 in.) of 11 ft. In the Upper Wassaw Forest Reserve, a very old tree was measured with a girth of 25 ft. 6 in. Another measured in the Bobiri F.R. had a bole 80 ft. high and was 15 ft. G.B.H. The bark is dark grey and fairly smooth , except for long, shallow growth cracks. It becomes darker and scaly when old. The slash is red-brown and thick, with white, vertical lines about ¼ in. wide. After a while, a yellow, slightly sticky exudation appears from the wound. In time it forms into a golden brown translucent gum. The sapwood is soft and is not differentiated from the heartwood in colour. The wood is white, not durable and is not used commercially.

BOTANY. The leaf is imparipinnate and may have from 5 to 10 pairs of opposite leaflets and a terminal one. The adult leaf is about 11 in. long, but the sapling leaf may be up to 25 in.



Antrocaryon micraster. 1. Seedling x 1. 2. Juvenile leaf.
3. Mature leaf.

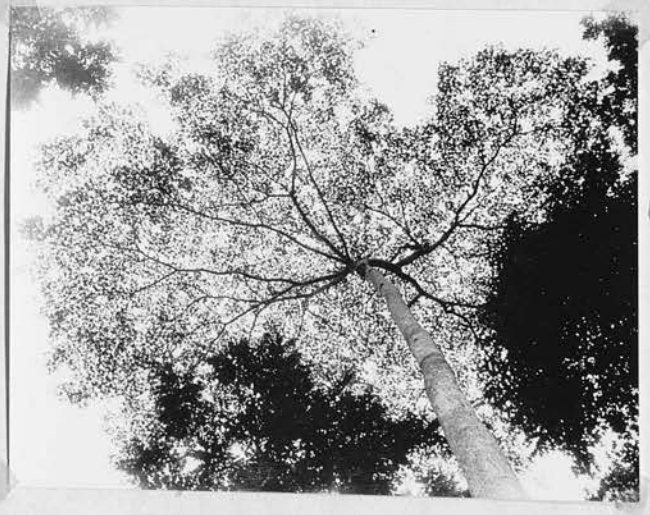
There are a few hairs on the petiole, but the rhachis and all parts of the leaflets are covered with white villous hairs. The leaflet is narrowly oblong, 3½ in. long and 1 in. broad, entire, acuminate and with a cordate base, and a very short petiolule, or sessile. The lamina is a dull, glaucous green above and light green below. The terminal leaflet is elliptic, entire, acuminate, cuneate and with a ½ in. long petiolule. The midrib of the leaflets is raised above and below. The secondary nerves are numerous and prominent. There is a tendency for the upper part of the midrib and the rhachis to be tinged with red. The flowers are in small white panicles about 6 in. long. The fruit is a globose drupe, about 2 in. diameter, with a hard, pitted endocarp in which are five large holes, each containing a seed. The ripe fruit has a disagreeable smell.

PHENOLOGY. The tree is deciduous from towards the end of November until about the end of January. The flush of new leaves is gradual, and may continue into March. The light green young leaves are tinged with red at their tips. Flowering begins with flushing and continues until the end of April. Ripe fruits begin to appear in September and are available until December.

SEEDLING. Germination is epigeal. The very slender hypocotyl is 4-5 in. long. The cotyledons are sessile and linear, 1.5 in. long and 0.2 in. broad. The first two primary leaves are about 2 in. above the cotyledons; they are opposite, trifoliate and petiolate. The terminal leaflet is ovate-elliptic, 2.5 in. long and 1 in. broad, entire, acuminate, broadly cuneate and with a thin petiolule 0.25 in. long. The lateral leaflets are oblong-lanceolate, entire, acuminate, rounded at the base and sessile. There are scattered white hairs on the leaflets, which are conspicuous on the margins. The succeeding leaves are alternate and imparipinnate, and are tinged with red. The primary shoot is slender and soft. There are no stipules.

DISTRIBUTION & SILVICULTURE. Antrocaryon is fairly common along the northern edge of the High Forest, where it is associated with Cistanthera papaverifera. It is conspicuous in the southern part of the Boumfum F.R., along the Kwahu Scarp, in the Worobong F.R., near Begoro, and in Togoland. Further south it becomes less frequent and is rare in the Rain Forest. A few specimens are known to exist in the S.W. of the Subri F.R. Enumeration figures give the foloowing frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11--
N. Scarp (E)	100	9	6	4	-	-
Bobiri	94	2	2	1	-	-
Onuem-Nyamibe Shelterbelt	62	4	1	1	-	-



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Antrocaryon micraster. 1. Crown. 2. Young bole. 3. Mature bole. 4. Fruit.

Antrocaryon is a light demander and requires overhead light, but preferably not too open conditions. It does not compete well against weeds and so is not common in Secondary Forest.

NATURAL REGENERATION. This is prolific and although the heavy fruit causes most of the seedlings to spring up near the mother tree, they are sometimes scattered quite far. It is likely that some of the smaller animals may help in distributing the seed. Where overhead light conditions are suitable, the seedlings develop quickly.

ARTIFICIAL REGENERATION. Germination begins in about a fortnight, but may continue as long as a year. Of a batch of 300 seeds sown, there were 15 seedlings in 19 days, 78 in 6 weeks, 102 in 10 months, and further germination took place after this. Seedlings were 12 in. high at the end of 6 weeks and 5 ft. in a year. As the young shoot is rather soft, transplanting is best done by using stumped plants. No attempt has been made to create plantations of this species.

FIELD NOTES. The tree is easily recognisable because of its crown and slash, and the sapling because of the glaucous green leaves tipped with red. It is confused with Panda oleosa on account of the similarity of the fruits. Those of Panda are usually 3 seeded. The leaves of Panda are simple whereas those of Antrocaryon are imparipinnate. Panda is an understorey tree with a dull, light liver coloured slash containing many black horizontal flecks.

2. LANNEA A.Rich.

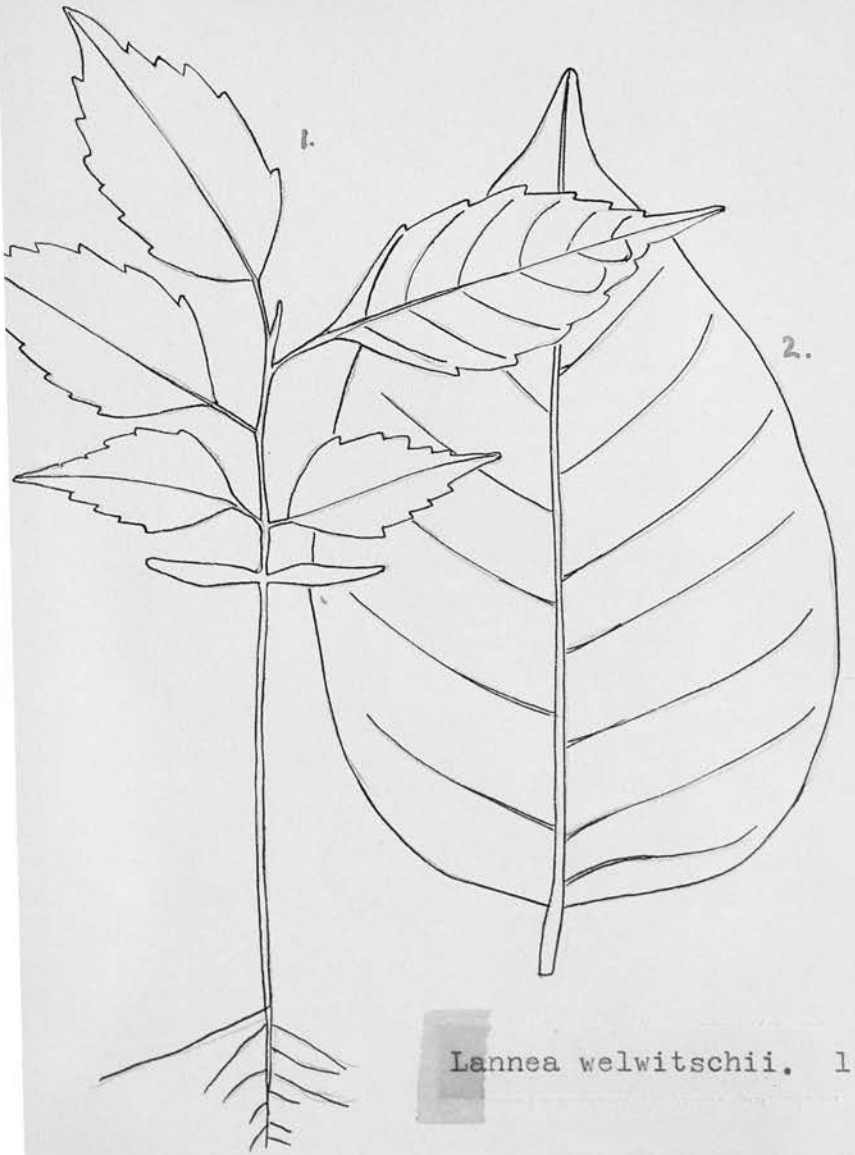
This genus is represented in the Savannah-Woodland by the trees L. acida A.Rich., L. kerstingii Engl.& Krause and L. velutina A.Rich., and by one species in the High Forest Zone. Often the species are characterised by twisted or pitted boles.

Lannea welwitschii (Hiern) Engl.

SYNONYM. L. acidissima A.Chev.

VERNACULAR NAMES. Bopire (S). Kumenini (Ash,T,W)

A medium sized tree without buttresses. Some old trees may be fluted at the base. The crown is light and rounded. The grey-brown bark is thick and contains prominent light brown scattered lenticels. There are depressions, usually wider than long, in the bark which give the bole a characteristic feature. The slash is red, similar to Khaya, and is slightly scented. The sapwood is white and soft. The heartwood may have a rosy tinge. It is soft, moderately light in weight and is not durable. Logs lying in the forest are readily attacked by borers. The wood is said to be woolly. It has a medium and even texture and a fairly straight grain. In transverse section, the vessels are just visible. With a hand lens, many fine medullary rays



Lannea welwitschii. 1. Seedling x 1. 2. Leaflet x 1. 3. Bole.

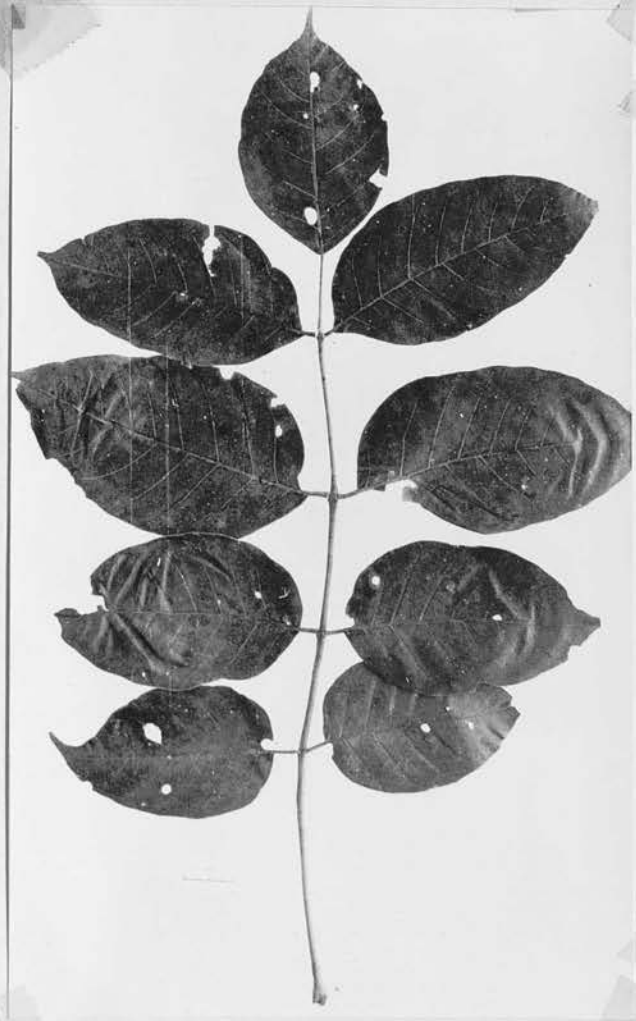
can be seen, separated from one another by a vessel diameter. The bark is used to prepare the saffron dye for funeral cloths, known as kuntunkuri (Ashanti).

BOTANY. The leaf is imparipinnate. There are usually 3 pairs of opposite leaflets and a terminal one. The leaflets are dark green and increase in size towards the apex of the leaf. The latter is about 13 in. long. The leaflet is elliptic, about 5 in. long and 3 in. broad, entire, acuminate, broadly cuneate and with a short petiolule which is channelled above. The midrib and secondary nerves are prominently raised below. The juvenile leaf bears fine white hairs which disappear soon. Its leaflets are oblong-lanceolate and more or less sessile; the terminal one is obovate and has a petiolule. The leaf of the young plant has usually a pupplish tinge below. The young shoots are softly pubescent. The small yellow flowers are borne in spikes at the ends of the branches. The tree is monoecious. There are 4 reduced sepals and 4 petals. The male flower contains 8 stamens and the female has a superior ovary of 4 carpels. The fruits are small, black, ellipsoid drupes, about $\frac{3}{4}$ in. long.

PHENOLOGY. The tree is deciduous in December and January, but may begin to lose its leaves in November. Flushing is universal in March, but full crowns may not be formed until April. The young flush has a bronze colour, which remains on the underside of the leaves for some time. The flowers are produced from December to early April, and the fruits are ripe in July and August.

SEEDLING. Germination is epigeal. The green, glabrous hypocotyl is about $2\frac{1}{2}$ in. long. The cotyledons are sessile and develop to become narrowly lanceolate, 0.5 in. long and 0.1 in. broad. The first two primary leaves are opposite and are borne on the shoot about 0.3 in. above the cotyledons. Succeeding leaves are alternate. The primary leaf is simple, oblong, 2 in. long and $\frac{3}{4}$ in. broad (3rd. leaf), with a long acuminate tip, cuneate and crenate. The short (0.4 in. long) petiole is flattened. The midrib and lateral nerves are prominent below. The 9th. leaf is usually the first to be compound. All parts of the seedling are glabrous. There are no stipules.

DISTRIBUTION & SILVICULTURE. L. welwitschii is found throughout the High Forest Zone, but never in quantity. It is a light demander and its habitat is damp places, especially on the edges of semi-swamps. Its associates are Carapa procera, Cleistopholis patens and Raphia vinifera. It does not like permanent swamps. Enumeration figures give the following frequencies:



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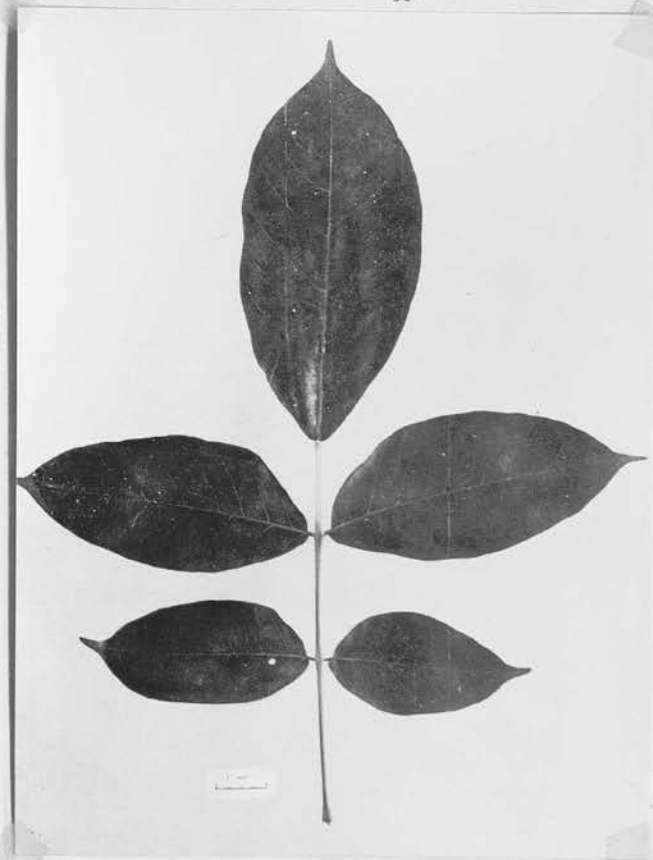

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Lannea welwitschii. 1. Mature leaf. 2. Juvenile leaf. 3. Tree.

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Kakum	150	40	15	9	2	-
Onuem-Nyamibe Shelterbelt	62	7	4	1	-	-
Bobiri	94	31	11	7	2	1
Afram Headwaters	185	14	9	4	-	-

NATURAL REGENERATION. This is fairly common in or near wet places. Birds help in distributing the seeds as they eat the enveloping pulp.

ANNONACEAE.

A family of trees and shrubs with characteristic 2-ranked, simple, exstipulate leaves. The flowers are usually hermaphrodite; the perianth is 3-merous, the stamens numerous and the superior ovary is apocarpous except in Monodora Dun.

This family contains trees of the lower storey of the High Forest. Annona senegalensis Pers. is a shrub or small tree of the Savannah-Woodland. The bark in this family is usually scented.

Some High Forest genera not dealt with below are: Anonidium Engl.& Diels., Enantia Oliv., Hexalobus A.DC., Monodora Dun. and Uvaria L.

GENERA. 1. Cleistopholis Pierre. 2; Pachypodanthium Engl.& Diels. 3. Xylopia L.

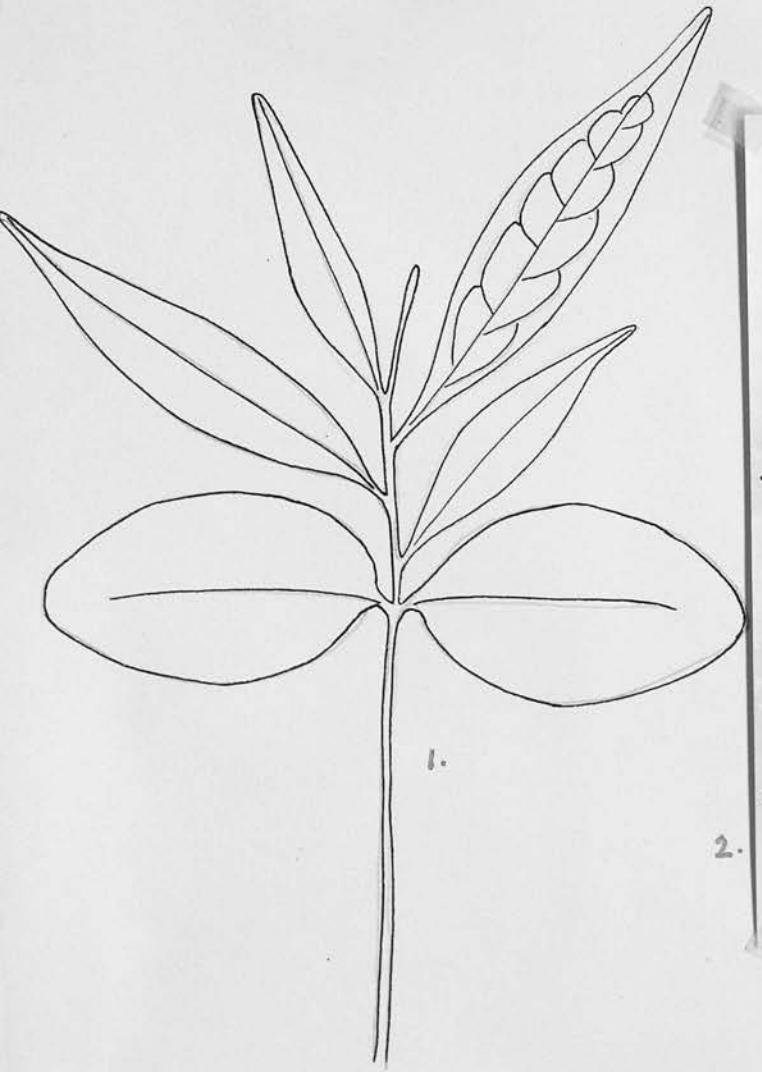
1. CLEISTOPHOLIS Pierre.

Cleistopholis patens Benth.

VERNACULAR. Aheri (Nz). Fotie (Ao,S). Nwo-ne-nkyene (Ash,T) - meaning 'oil and salt' because of the taste of the bark. Obite (W).

A medium sized or small tree, usually about 60 to 80 ft. high and 5-7 ft. G.B.H. A particularly large tree was measured in the Yoyo F.R. and was 140 ft. high and 10 ft.3 in. G.B.H. - by far the biggest seen by the writer. The bole is usually slender, cylindrical and straight. It is not buttressed but has close root spurs. The crown is small in width but deep and spreading when young. The branches are borne more or less horizontally. The bark is smooth and may be black when young, but becomes silvery grey later. The slash is thick, white, fibrous and with a highly spiced scent. The sapwood is white and has a sheen. The heartwood is soft, white and with a silky sheen and splits easily. It weighs 20-30 lb. per cu.ft. seasoned. It is not durable and is very liable to stain. In transverse section may be seen many fine medullary rays and fine bands of parenchyma unrelated to the few scattered vessels. Formerly the bark was used for native sandals, as it peels readily.

BOTANY. The alternate, glossy, green, narrow leaves give the appearance of being compound because of their regular arrangement in a horizontal plane along the branches. The leaf is simple, exstipulate, oblong-lanceolate, up to 10 in. long and 2½ in. broad, entire, acuminate and with a rounded base and a short petiole (0.2 in. long). The lamina is dark, shiny green above and light green below. The midrib is depressed above but raised below. The small yellow-green flowers are borne in the leaf axils. The 3 sepals and 6 petals are very small. A fruit



Cleistopholis patens. 1. Seedling xl. 2. Branchlet with fruits.
3. Tree.

cluster consists of up to 8 apocarpous carpels, each on a stout stalk. When ripe the fruit is black, about ¾ in. long and ½ in. diameter, and may be 1 or 2 seeded. The seed is brown and round on one side but flat on the other.

PHENOLOGY. The tree is evergreen. Flowers are produced from January to March, and the fruits are ripe from August to November. Very few flowers and fruits are produced by a single tree and not many trees are in bearing during the same year.

SEEDLING. Germination is epigeal. The hypocotyl is 4-5 in. long. The cotyledons expand to become foliaceous. They are elliptic, about 2 in. long and 1¼ in. broad, entire, obtuse or rounded, and with very short petioles. The primary leaves are alternate, simple, lanceolate, 2½ in. long and ½ in. broad (2nd. leaf), entire, acuminate, cuneate and with short petioles; the first one is borne about 0.2 in. above the cotyledons. All parts of the seedling are glabrous.

DISTRIBUTION & SILVICULTURE. C. patens is found throughout the High Forest Zone and in the Riparian Forest of the southern part of the Guinea Savannah-Woodland. It is a light demander, and its greatest frequency is in wet areas, such as the margins of swamps. There its associates are Carapa procera, Lannea welwitschii and Raphia vinifera. It is also found growing beside watercourses.

NATURAL REGENERATION. Despite the small amount of seed that is produced, many seedlings are to be seen in April, especially in semi-open places in the forest and where it is damp. Growth is fast and a strong shoot is soon produced.

2. PACHYPODANTHIUM Engl.& Diels.

Pachypodanthium staudtii Engl.& Diels.

VERNACULAR. Awasa-makyina (W). Dankwakyire (Ash). Duawisa (W). Fale (Nz). Kumdwe (W). Okyeraa (Ash). Pediasa (Ash).

A mediulm sized tree of the High Forest Zone. The bole is straight, cylindrical, clear of branches for most of its length, and is not buttressed. A specimen felled in the Bobiri F.R. measured 150 ft. overall, with a bole of 97 ft. and 6 ft. 11 in. G.B.H. Girths seldom exceed 8 ft. B.H. The crown is small and the branches are thin and relatively short. The dark leaves are pendulous and their undulate margins are conspicuous. The bark is thick and hard (thus the generic name of 'hard skin' - Latin). It is dark brown and slightly fissured. The yellow slash which turns brown quickly on exposure, is strongly scented. The bark is boiled and used as a chest medicine and also for killing lice (the name 'kumdwe' means to kill lice). Trees occurring near where people pass by usually show signs of having had parts of the bark cut off for medicinal purposes. The wood is yellow-white and moderately hard. In transverse section, a few scattered vessels and many

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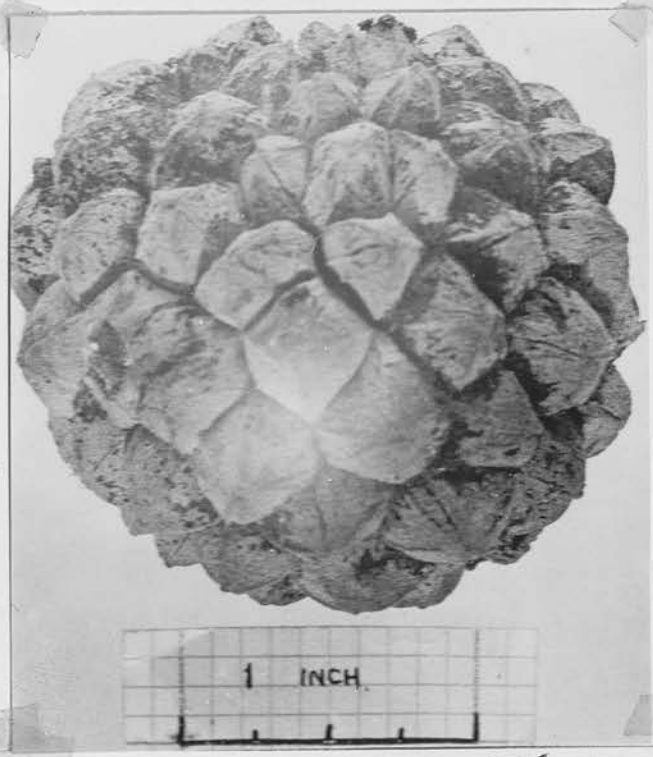


3.

4.

Pachypodanthium staudtii. 1. Seedling x 1.
2. Tree. 3. Fruit. 4. Leaves.

few scattered vessels and many, close medullary rays may be seen. With a hand lens, close, narrow bands of parenchyma are evident. On the radial section the medullary rays appear fairly deep and brown.

BOTANY. The simple leaf is oblong-lanceolate, about 9 in. long and 1½ in. broad or smaller, tapering to both ends, with an undulate margin and a short (¼ in. long), swollen, velvety petiole. The leaf is glabrous, shiny dark green above and lighter dull green below. The tip is acute to obtuse, and the base is slightly auriculate. The leaves are alternate.The buds, petioles and young branchlets are covered with golden brown tomentose hairs. The flowers are pale yellow. There are 3 sepals, 6 petals, many stamens and many carpels, with an ovule to each of the latter. The woody, cone-like fruit, about 2 in. diameter, is borne on a stout, ½ in. long woody stalk, and is made up of loosely united carpels. The seeds are red.

PHENOLOGY. The tree is evergreen. Flowering takes place from March to May, but there is also a record of flowers in October. The fruits are ripe from September to December, but may persist on the tree for a month or two after that. A dry period helps the fruits to open on the tree, but many usually fall unopened.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, and is slender, woody and brown. The sessile cotyledons develop and become almost orbicular in shape, with a diameter of ¾ in. The primary leaves are alternate and sessile. The 3rd. leaf is simple, obovate-elliptic, 2¼ in. long and 1 in. broad, entire, broadly acuminate and exstipulate. The fine midrib is slightly raised below. There is some sparse pubescence on the stem.

DISTRIBUTION & SILVICULTURE. Pachypodanthium is found throughout the High Forest Zone, but never in quantity. It has been recorded from the Bia Tano F.R. and Mampong (Ashanti) in the north to the Ankasa F.R. in the south-west. This tree appears to prefer well drained but moist soils. It is a light demander, but will tolerate medium shade in youth.

NATURAL REGENERATION. Natural regeneration is not uncommon, but there is a big wastage of seed because of so many of the fruits falling unopened and rotting on the ground. The seedlings do not thrive under a dense canopy. Height increment is about 6 in. a year in the early stages.

3. XYLOPIA L.

The trees of this genus do not attain large girths. Some of them develop stilt roots. Besides those described below, mention may be made of two species which are comparatively rare - X. aethiopica A.Rich., which has been recorded as a small spreading

Xylopia staudtii. 1. Stilt roots. 2. Seedling x 1. 3. Fruit x 1. 4. Seed x 1. 5. Leaf x 1.

Xylopia quintasii. 6. Leaf. 7. Fruit. 8. Seed. 9. Seed without the aril. All x 1.

tree 15 ft. high at Essiama, near the sea, and also found in the Togo Plateau F.R.; and X. vallotii Chipp ex Hutch.& Dalz., which is not unlike X. villosa, but is less villose. It is a riparian tree of the High Forest and the southern Savannah-Woodland.

SPECIES. (i) X. quintasii Engl.& Diels. (ii) X. staudtii Engl. ex Hutch.& Dalz. (iii) X. villosa Chipp.

(i) Xylopia quintasii Engl.& Diels.

SYNONYM. X. lane-poolei Sprague & Hutch. X. parviflora A.Chev. X. striata Engl.

VERNACULAR NAMES. Asima (W). Erale (Nz). Obaa (Ash,S?T,W).

A tree with a slender bole seldom exceeding 70 ft. high and 4 ft. G.B.H. The buttresses are short. The crown is small and is composed of short, thin, horizontal branches. The dark, brown bark flakes off in regular, thin, narrow strips. The slash is brown and fragrant. The wood is dark yellow-brown, heavy and hard. It is reasonably durable against termites. Its uses are for house posts and rice pestles.

BOTANY. The leaf is simple, obovate-elliptic, about 4 in. long and 2in. broad, entire, broadly acuminate, cuneate and glabrous. It has reticulate venation which is not visible on the upper surface. The pointed buds are covered with silky hairs. The small white flowers are borne in the leaf axils. The 3-5 carpels form a pod-like fruit, each unit being about $1\frac{3}{4}$ in. long and 0.4 in. diameter and more or less sessile, and opening longitudinally along one side. There are about 3 seed in each fruit, and each is surrounded with a red-brown aril which is united to the base of the seed but free at the apex. The aril is divided into thread-like parts which are so close that they envelop the seed. The seed is about $\frac{1}{2}$ in. long and $\frac{1}{4}$ in. broad, brown and smooth.

PHENOLOGY. The tree is evergreen. The new leaves in June and July are tinged with red. Flowering takes place between December and March, and fruits are available from July to October.

DISTRIBUTION & SILVICULTURE. X. quintasii is found throughout the High Forest Zone but is not common. It is often found growing near moist situations, but it does not inhabit swamps.

ARTIFICIAL REGENERATION. There are about 110 seeds (without aril) to an ounce.

The genus is easily recognised by the habit of the crown and bole. This species has a similar leaf to X. staudtii, but the reticulate

venation of the latter is visible to the naked eye on the upper surface, whereas it is not in the leaf of X. quintasii, where it is obvious only on the lower surface.

(ii) Xylopia staudtii Engl. ex Hutch.& Dalz.

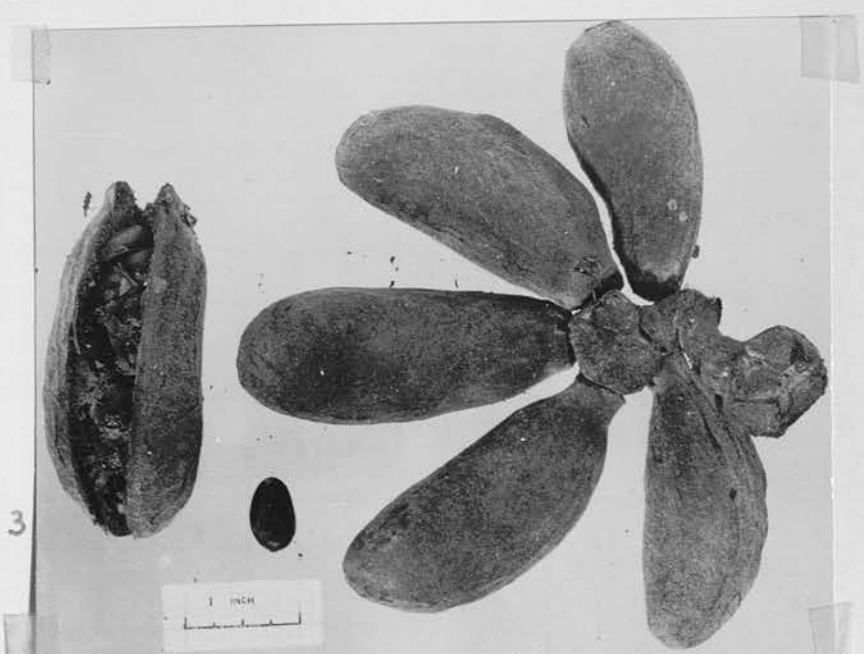
VERNACULAR NAMES. Alari(Nz). Donga (Nz). Duanan (W).

A tree with a slender bole seldom greater than about 80 ft. high and 5 ft. girth. It has thin stilt roots, which do not spread far. The crown is small and consists of short, thin, horizontal branches. The light brown bark flakes off in long, 1 in. wide strips. The bark is thick and fibrous, and the slash is dull brown and has a slightly aromatic scent.. The whitish sapwood has a sheen and it turns yellow-brown on exposure. In the pole stage the bark is light grey and smooth. The heartwood is light brown and lustrous. It is relatively light but strong, but is said to be not very durable. It has a straight grain and is easy to work. The wood is used for house poles and the bark for rope. In transverse section, the medullary rays and parenchyma are very prominent.

BOTANY. The leaf is simple, elliptic, about 4 in. long and 2 in. broad, entire, bluntly acuminate and broadly cuneate. The midrib is depressed above and raised below. The faint secondary nerves are looped well within the margin. The reticulate venation is conspicuous, although fine. The upper surface of the lamina is shiny green and the lower one dull and paler. The petiole is short and is channelled above. The young shoots, the pointed buds and the undersides of the leaves are covered with golden brown silky hairs, which disappear in time. The small yellow flowers are borne in the axils of the leaves. The infructescence is made up of pod-like fruits, which are black and shiny, each about 2½ in. long and ½ in. diameter, with a short, stout stalk. The fruit is slightly constricted between the seeds. These may be 1-4 in number and are embedded in a scented red pulp. The seed is black and shiny, 0.5 in. long and 0.4 in. broad, and is surmounted by an orange, pin-pointed aril.

PHENOLOGY. The tree is evergreen. Profuse flowers are produced in August and September and fall to the ground early. The fruits are ripe from January to March. Some may persist on the trees until the next flowering begins.

SEEDLING. Germination is epigeal and the hypocotyl is about 3 in. long, light brown and semi-woody. The leaves are alternate, obovate-elliptic, about 2 in. long and 1 in. broad, entire, broadly acuminate (the later ones are acuminate), thin, glossy above, and a very light, dull green below, and have slender petioles about 0.3 in. long. The midrib is depressed above and raised below. The venation is reticulate. The pointed buds,



Xylopia villosa. 1. Branchlet x 1.
2. Seedling x 1. 3. Fruits & seed.

and the undersides of the new leaves are covered with golden brown silky hairs at first.

DISTRIBUTION & SILVICULTURE. X. staudtii is confined to the Rain Forest and to the wetter parts of the Lophira-Triplochiton Association. It is to be found on hillsides, in valleys, near to running water and in seasonal swamps, but is more usual in wet places. Stilt roots are developed, no matter the situation of the tree. It does not seem to like Secondary Forest, or at any rate, young Secondary Forest. The tree succeeds where the overhead canopy is not too dense.

NATURAL REGENERATION. This is plentiful near the mother tree in May and June. Many of the fruits fall unopened, especially in wet atmospheric conditions. Regeneration is also to be seen in partial shade, such as along roads and in small openings in the forest. The whippy young stems are easily bent over by climbers. Branches are formed early in the sapling and these afford a chance for climbers to make their way up to the leading shoot and so bend it over. Where light conditions are favourable, the growth of the sapling is fairly fast, but an annual height increment of only 6 in. is fairly common in the younger stages.

FIELD NOTES. See X. quintasii. Like other species of Xylopia a spot character of the young plant is the scented branchlet or shoot when broken.

(iii) Xylopia villosa Chipp.

SYNONYM. X. macrocarpa A.Chev.

VERNACULAR NAMES. Obaa fufuo (Ash,T) - meaning white Xylopia.

A tree with a slender stem, reaching about 70 ft. high and about 4 ft. G.B.H. The bole may be fluted, and it is slightly buttressed. The small crown consists of short, thin, horizontal branches. The bark is light grey and flakes off in long, narrow strips. The thin slash is light brown and sweetly scented. The light brown sapwood is hard.

BOTANY. The leaf is simple, oblong-lanceolate, about 3 in. long and 1 in. wide, entire, acuminate, with a rounded base and a very short petiole. The lamina is glabrous above, but below it is covered with a mat of red velvety hairs (which give the tree its specific name). The midrib is depressed above and raised below. The secondary nerves are visible, but are not prominent. The pointed buds are covered with brown, silky hairs. The light yellow flowers are axillary. The infructesence is made up of separate carpels, and each fruit is about 2½ in. long and 0.8 in. diameter, with a velvety surface.

PHENOLOGY. The tree is evergreen. Flowers are produced in October and November, and the fruits are ripe in June and July.

SEEDLING. Germination is epigeal and the hypocotyl is about 5 in. long, slender, dark brown, glabrous and woody. The stem is woody, very slender and covered with golden brown tomentose hairs. The leaves are alternate and are simple, oblong-lanceolate, about 2 in. long and $\frac{3}{4}$ in. broad, entire, acuminate, broadly cuneate, and with a very short, slender petiole. A mat of golden brown villose hairs covers the mid-rib above and below, and also the petiole; similar hairs are scattered over the underside of the lamina.

DISTRIBUTION & SILVICULTURE. The tree is found in the High Forest Zone from Togo Plateau F.R. to the S.W. corner of the Subri F.R., but is rare. It seems to like being near water but it is also found well away from it.

FIELD NOTES. This species and X. vallotii are easily distinguished from the other Xylopias because of the golden brown villose hairs.

APOCYNACEAE.

A family well represented in the Gold Coast, but mainly as herbs, shrubs, lianes and small trees. The only tree reaching the upper storey of the High Forest is Alstonia. Conopharyngia G.Don., Rauvolfia L. and Voacanga Thouars are common understorey trees throughout the High Forest Zone. The liane, Landolphia Beauv. used to be tapped for rubber. Strophanthus DC., whose species are found throughout the Gold Coast as shrubs and climbers, is a source of arrow poison. This genus has achieved a new importance as cortisone may be prepared from it. This drug is being used in the treatment of arthritis and rheumatic fever.

Members of this family have simple, opposite or whorled, usually exstipulate leaves, and produce a copious white latex. The flowers are hermaphrodite, regular, usually pentamerous and the fruit is typically composed of 2 follicles, which may be dehiscent or not.

GENERA. 1. Alstonia R.Br. 2. Funtumia Stapf 3. Holarrhena R.Br. 4. Picralima Pierre.

1. ALSTONIA R.Br.

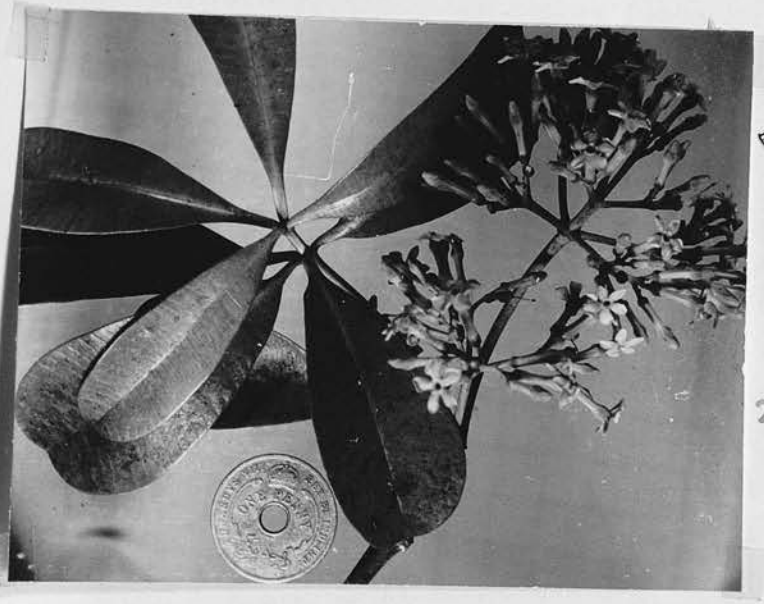
Alstonia boonei De Wild.

Previously confused with, and recorded as A. congensis Engl.

VERNACULAR NAMES. Adawra (Ad). Bakunin (Nz) Emenle (Nz). Nyamelebaka (Nz). Onyame-dua (Ash,T). Sindru (Ash, F,T,W). Onyame-dua means god's tree and is derived from the fact that a piece of the young shoot with its whorled branches is used to support fetish bowls.

TRADE NAME. Alstonia.

A straight tree of the upper canopy of the High Forest. A specimen felled in the Bobiri F.R. was 138 ft. high, with a bole of 64 ft. and a girth above buttresses of 10 ft. 5 ins. The bole appears to be buttressed, but a better description would be that it has deep, high fluting. The leading shoot sometimes develops from a dormant bud immediately below the uppermost whorl. The crown is small and is made up of horizontal, whorled branches. It is not uncommon to find a tree 'weeping' in March, through, presumably, an exudation of water from the leaves. The bark is grey, rugose and thick and is covered with scattered, prominent lenticels. The slash



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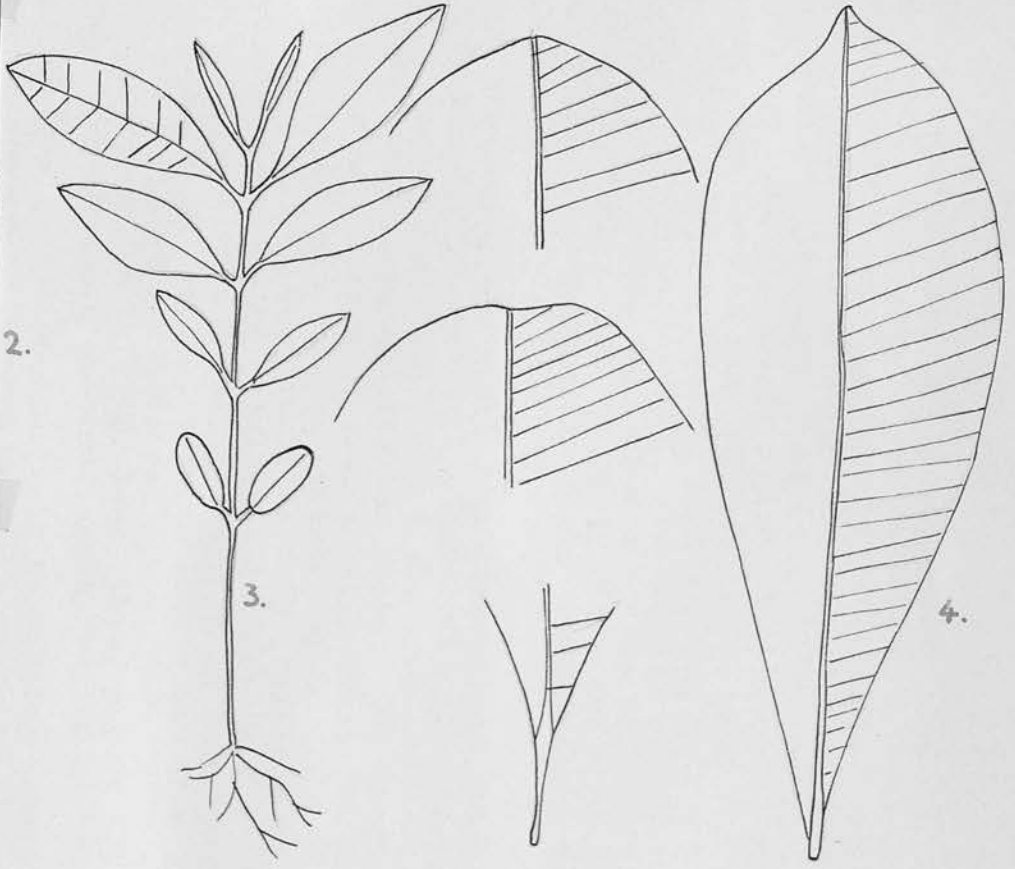


1.

Alstonia boonei. 1. Bole. 2. Flowers & leaves.
3. Seedling x 1. 4. Leaf x 1.

is yellow and granular, and freely exudes a white, slightly sticky latex. The wood is yellowish-white throughout, and there is no visible distinction between sapwood and heartwood. It is light, soft, of uniform texture, but not durable, and stains readily. It weighs from 19 to 27 lb per cubic foot when air dry, and can absorb 50% of its volume of water in 1½ hours. The wood is easy to work and is used for carving dolls, fetish emblems, dishes, platters and native stools. It is said to hold nails well. The bark is boiled in water as a cure for malaria. An infusion of the bark is used to alleviate toothache. This property gives the tree its name Sindru, which is a corruption of the words meaning tooth medicine.

BOTANY. The leaves are whorled at the ends of the branches. The glabrous leaf is obovate (oblanceolate sometimes, especially when on a young plant) and about 5 in. long and 2 in. broad. It is dark green above and lighter below. The margin is entire and the apex may be obtuse, rounded or retuse. The base of the lamina is cuneate and the petiole may be about ½ in. long or very short. The midrib is very prominent on the underside and so are the parallel secondary nerves which are at right angles to the midrib. There is an intramarginal nerve which may not be easily seen. The ½ in. long yellowish flowers are borne in lax terminal cymes. The fruit consists of twin follicles, up to 2 in. long, thin, papery and straw coloured. They contain numerous seeds, tufted at both ends.

PHENOLOGY. The trees are deciduous at varying times from November to January. This is when the prolific flowering takes place. Fruits are produced in March and April, but very few seeds are formed. The seeds are wind distributed.

SEEDLING. Germination is epigeal and the hypocotyl is about 1½ in. long. The cotyledons become foliaceous and are oblong, 0.8 in. long and 0.4 in. broad, obtuse and with 0.2 in. long petioles. The leaves are opposite and the first pair is about ¾ in. above the cotyledons. They are oblong-lanceolate, about 1½ in. long and ½ in. broad (3rd. pair), acute and cuneate and with a petiole about 0.4 in. long. The underside of the lamina is lighter green than the upperside. The secondary nerves are more or less parallel with each other. All parts of the seedling are glabrous.

DISTRIBUTION & SILVICULTURE. Alstonia is a light demander found throughout the High Forest Zone and in the Riverain Forest of the southern Guinea Savannah-Woodland. It is a constituent of the vegegation bordering freshwater swamps. In general it prefers damp situations, but grows satisfactorily on well drained slopes. It is a coloniser of gaps in the forest and also occurs in young Secondary Forest.

The following frequencies are recorded from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Kakum	150	44	25	9	7	-
Asenanyo	77	4	5	2	-	-
Bobiri	94	19	7	2	2	2
Afram Headwaters	185	47	28	17	6	1

NATURAL REGENERATION. The tree does not produce much seed, but in June quite a lot of regeneration may be seen in the more open places in the forest. Growth is rapid, and it is not uncommon for an annual height increment of 6 ft. to be recorded in the sapling stage. A strong shoot is ent up above a whorl of branches. The tree coppices readily.

ARTIFICIAL REGENERATION. There are about 1,000 seeds to the ounce. The germination period is from 15 to 25 days and the plant percentage at the end of six months is about 85. For transplanting, either stripped or stumped plants succeed. Growth is irregular. The following records are from a small plantation at Kumasi:

Years	Height	Girth
1½	2 ft. 6 in.	-
3	4-15 ft.	-
10	14-50 ft.	5½ in.- 2 ft. 6 in.

FIELD NOTES. In the seedling and early sapling stages, Alstonia may be mistaken for Conopharyngia. The leaves are similar, but the nervation of Alstonia is more distinct. Alstonia tends to have an erect habit, whereas Conopharyngia assumes a more spreading form.

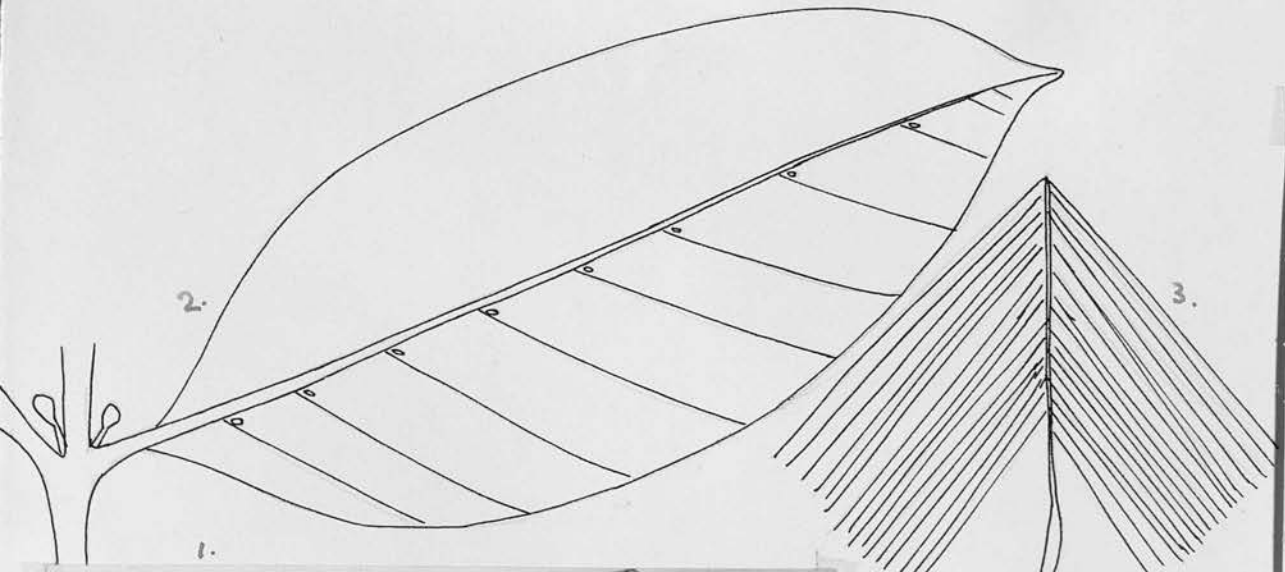
2. FUNTUMIA Stapf

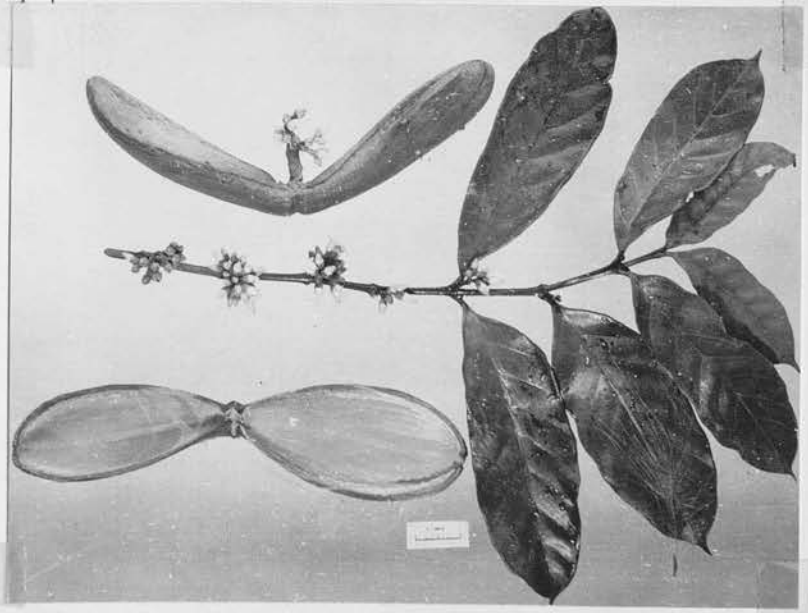
There are two species, which are trees of the lower storey of the High Forest. They were a source of rubber before Para rubber became plentiful. During the Second World War, they regained a short lived economic importance as rubber producers after the fall of Malaya. The two species are similar in many respects, and only the second one is treated in detail here.

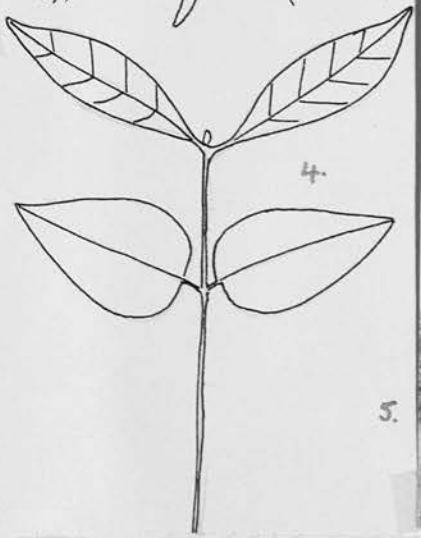
SPECIES. (i) F. africana Stapf (ii) F. elastica Stapf

(i) Funtumia africana Stapf

VERNACULAR NAMES. Funtum (Ash,T,W). Fulmuntu-okai(Nz). Kpomi (E). Mama (Ash). Both species are referred to as 'bush rubber'.







Funtumia elastica. 1. Flowering branchlet and fruits. 2. Leaf x 1. 3. Seed x 1. 4. Seedling x 1. 5. Tree.

A tree, seldom exceeding 80 ft. high. One felled near Kumasi had a height of 73 ft. (58 ft. bole and 25 ft. crown) and 4 ft. 3 in. G.B.H. The exudate is not as sticky as F. elastica; it gives a poor quality rubber.

BOTANY. The principal difference from F. elastica is that minute tufts of hairs occur in the nerve axils on the underside of the leaf.

DISTRIBUTION. Found almost exclusively in the Rain Forest and in the nearby Lophira-Triplochiton Association, and in Togoland. This is a strange distribution because of the drier flora of Togoland. Occasional specimens are to be found in other parts of the High Forest Zone.

(ii) Funtumia elastica Stapf

VERNACULAR NAMES. Aman (Ash). Efunmuntum (Ao,Nz). Fulmuntu (Ash,T,W). Aman is the Ashanti name for rubber.

A tree not usually greater than 80 ft. high and 5 ft. G.B.H. The bole is cylindrical, but not quite straight. The crown is small, dense and dark, and tends to be deep. The bark is thin, light grey or blackish; on those trees which have been tapped, a wide herring bone series of cuts may be seen almost the whole length of the bole. The slash is flesh coloured and the sapwood white; the milky white sticky latex flows freely. The wood is white and there is no visible difference between heart and sapwood. It is moderately light (about 28 lb. per cu. ft. at 12% moisture content), soft and not durable. It has a fine texture and is used for carving native stools. With a hand lens, small scattered vessels and numerous fine medullary rays may be seen in transverse section. The latex is no longer tapped for rubber. When the tapping for latex took place, the cuts were made about 12 apart, right round the stem and sloping down to a central vertical cut. A tree was tapped in a day and about 2 gallons of latex obtained. The next tapping took place a year later. The floss from the seeds yields a fine, white kapok which is much preferred by the natives to the kapok of Bombax and Ceiba for pillows.

BOTANY. The leaves are opposite, simple, oblong-elliptic, about 5½ in. long and 2½ in. broad, with a short, broad acumen and a cuneate base. The petiole is short (¼ in. long) and thick. The upper side of the lamina is glossy dark green, and the lower side dull light green. The lamina does not lie flat, but is slightly wavy. The midrib and nerves are prominent below. There is a small pit in the axil formed by a nerve with the midrib. The dark, blackish-brown branchlets, which are flattened above and below

flattened above and rounded below, bear the profuse, small, white axillary flowers. The fruit consists of twin, black, boat shaped follicles; each is about 5 in. long and 1 in. in width, and contains many seed. The brown seed is surmounted by a slender 2 in. long stalk bearing fine silky floss, also about 2in. long.

PHENOLOGY. The tree is evergreen. Flowering begins in January and continues until May. Mature fruits are available from December to March. In fact, flowering begins while fruiting is going on. The follicles open on the tree and the light seed is blown far and wide; it is very noticeable floating through the air, especially on the outskirts of villages. There is an abundance of seed each year.

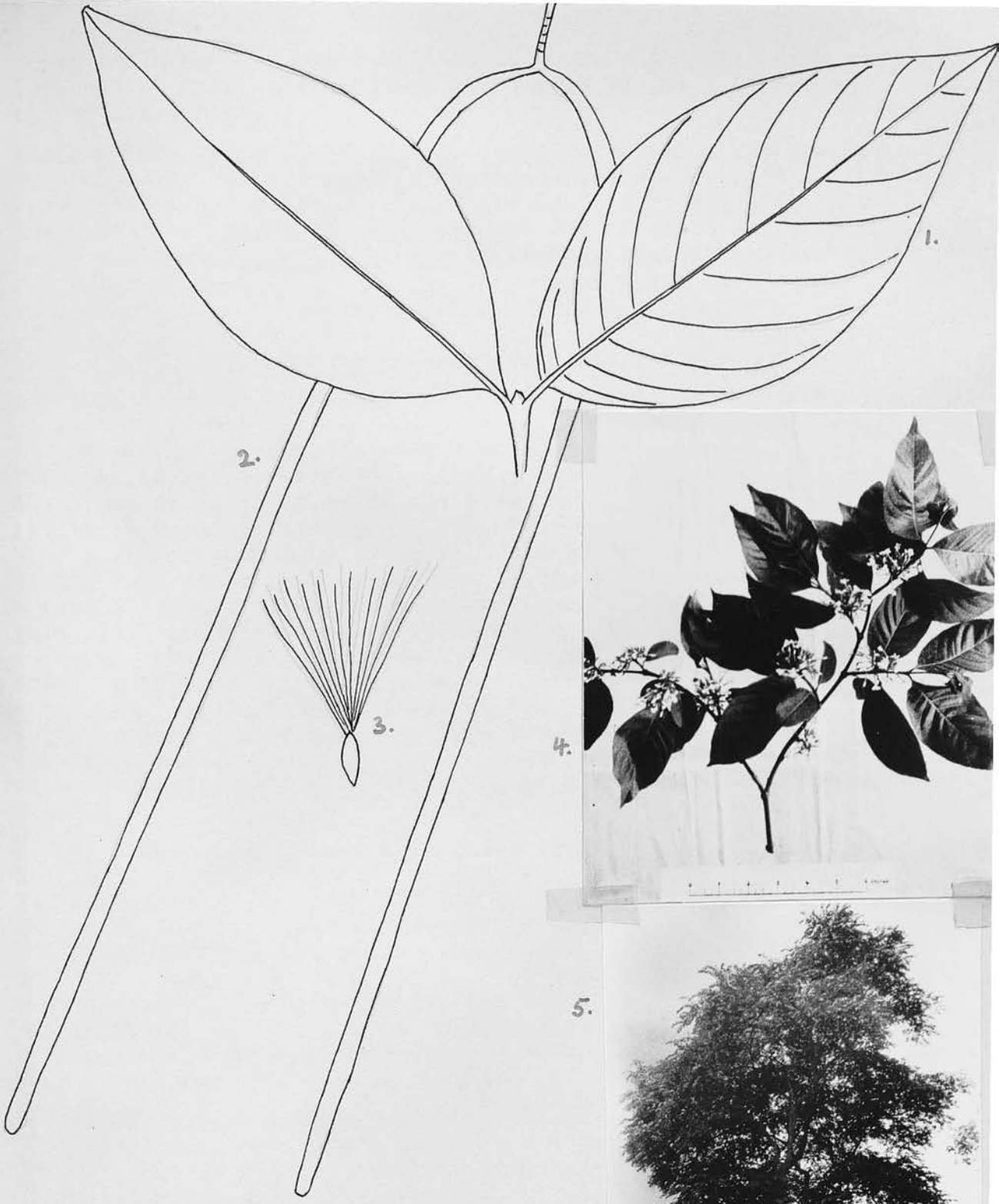
SEEDLING. Germination is epigeal. The green hypocotyl is about 2 in, long. The cotyledons become foliaceous; they are simple, ovate, about 1 in. long and ½ in. broad, entire, acute, with a rounded base and shortly petiolate. The first pair of opposite leaves is produced about 1¾ in. above the cotyledons. The leaf is simple, oblong-lanceolate, about 1 in. long and 0.4 in. broad, entire, acuminate and cuneate, with a short petiole.

DISTRIBUTION AND SILVICULTURE. F. elastica is found over most of the High Forest Zone, but has not been recorded from the Rain Forest and Togoland. It is a light demander, and although found in the lower storey, it is principally a coloniser of gaps in the forest and other open places. It is common in Secondary Forest. In a part of the Mpameso F.R. it forms a large proportion of the lower storey in what appears to be disturbed forest. Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes - ft. 3-5	5-7
Onuem-Nyamibe Shelterbelt	62	11	1
Bobiri	94	7	1
Amama Shelterbelt	109	15	1

NATURAL REGENERATION. This is abundant, and well distributed because of the light. pappiferous seed. Germination is high and growth is rapid in the young stages. The seedling will bear a certain amount of shade, but prefers more open conditions. It is not readily killed by climbers as it is able to send up a new shoot if the main one is smothered. The species does well in young cocoa farms, and is often to be seen as a standard in older farms.

ARTIFICIAL REGENERATION. As the species is so common, no attempts are known of it being tried as a plantation crop.



Holarrhena wulfsbergii. 1. Leaves.
2. Fruits. 3. Seed. All x 1.
4. Flowering branchlet. 5. Tree.

There are about 650 seeds to 1 ounce. The germination period is about 12 days, with a plant percentage of about 90 at the end of six months.

FIELD NOTES. F. africana and F. elastica resemble one another very closely, but are readily distinguished by the pits in the nerve axils on the lower side of the leaf in F. elastica, and the absence of these in F. africana. The tufts of hairs in the nerve axils of F. africana are not readily seen by the naked eye.

3. HOLARRHENA R.Br.

Holarrhena wulfsbergii Stapf

VERNACULAR NAMES. Edrokoza (Nz). Gakpotɨ (E). Sese (Ash,T,W).

A small tree, rarely exceeding 70 ft. high and 5 ft. G.B.H. The bole is fairly straight, but may bend slightly. Usually the crown is quite close to the tree, but tends to spread a little in isolated specimens. The branches are slender, bear many lenticels and tend to droop. The bark is light brown, rough, thin and scaly. The slash is light brown and there is a copious exudation of milky white latex. The wood is white or pale yellow. There is no visible difference between heart and sapwood. The wood has a fine texture, is easily worked, weighs about 34 lb. per cu. ft. air dry, and is not durable. In transverse section, small vessels, tending to be arranged in small, radial groups and many fine medullary rays separated by usually a vessel diameter, can be seen by means of a hand lens. This is considered the best white wood by the carvers of native stools.

BOTANY. The simple, opposite leaves are elliptic, 3-5 in. long and 1½-3 in. broad, entire, broadly acuminate and more or less rounded at the base. The slender petiole is about 0.2 in. long. The small, white, scented flowers are borne in dense cymes. There are five sepals, petals and stamens, and the superior ovary is composed of two carpels. The fruits are twin, slender, pendulous follicles, about 9-15 in. long. Inside are numerous, small, brown, pointed and somewhat flattened seeds, about 0.4 in. long. Each has a pappus of white silky hairs, a little over 1 in. long, borne at one end.

PHENOLOGY. The tree is deciduous from December to March, but individuals may not remain leafless during the whole of this period. The profuse flowers are produced from March to July. Ripe fruits are available from December to April. They are conspicuous when the tree is leafless. A large quantity of seed is produced which is liberated on the tree by the splitting of the follicles. It is effectively dispersed by wind.

DISTRIBUTION & SILVICULTURE. Holarrhena is found throughout the High Forest Zone, but is more common along its borders with the Savannah-Woodland. It is fairly common in the Derived Savannah-Woodland of Togoland. With such a distribution it seems strange to have it recorded from the Ankasa and Cape Three Points F.Rs. in the Rain Forest. The tree is a light demander and readily colonises Secondary Forest. It is frequently seen near villages and in old farm land in Northern Ashanti, in Togoland and in the ecotone between the High Forest and Coastal Scrub from near Swedru to Nsawam. It does not like damp situations.

NATURAL REGENERATION. This is plentiful; seed dispersal is good and so is the viability. The germination period is about 18 days. The young plants grow quickly, especially in fairly open conditions. It is not uncommon to find groups of trees of this species.

FIELD NOTES. Holarrhena is readily distinguished from Funtumia by its rough bark, much longer and thinner follicles and more open crown.

4. PICRALIMA Pierre

A genus containing very small trees in the High Forest. It differs from Alstonia, Funtumia and Holarrhena in that its mericarpic fruits are not follicles.

SPECIES. (i) P. elliotii Stapf (ii) P. nitida Th.& Hél.Dur. (iii) P. umbellata Stapf

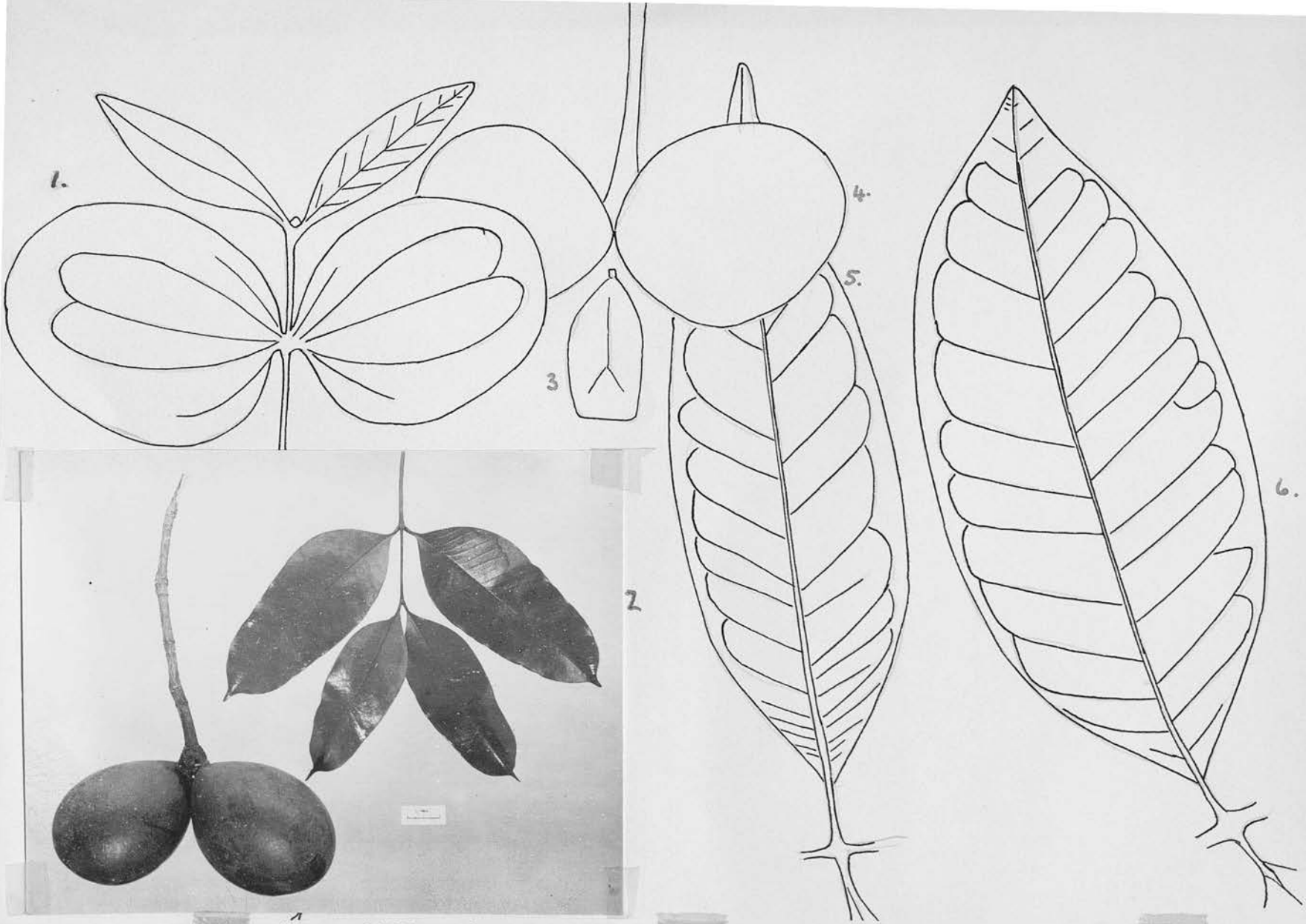
(i) Picralima elliotii Stapf

SYNONYMS. Polyadoa elliotii Stapf. P. gracilis A.Chev.

VERNACULAR NAMES. Akuamma (F,W). Kanwini (Ash,T) Kakooli (Nz). These names are applied to all species of Picralima.

A small tree seldom exceeding 30 ft. high and 2 ft. G.B.H. and often smaller. The bole is short and the branching low. The bark is dark and the slash light brown. The latex is milky white. The wood is hard and dense.

BOTANY. The opposite leaves are oblong-lanceolate, about 5½ in. long and 1½ in. broad, entire, acuminate and broadly cuneate. The slender petiole is about 0.4 in. long. The midrib and the very fine nerves are raised below. The small yellow-white flowers are borne in umbels. The fruit consists of paired, globose, yellow mericapps; one is often bigger than the other. An average size for a fruit is a little over 1 in. diameter.



Picralima nitida. 1. Seedling x 1. 2. Leaves & fruits. 3. Seed x 1.
P. elliottii. 4. Fruits x 1. 5. Leaf x 1. P. umbellata. 6. Leaf x 1.

PHENOLOGY. The tree is evergreen. Flowering takes place in March and April and the fruits are ripe in August and September.

DISTRIBUTION & SILVICULTURE. This species is found in the understory of the Rain Forest, where it is fairly common, and in the adjoining areas of the Moist Semi-Deciduous Forest. Further away, it is recorded from the Southern Scarp F.R. It is a shade bearer and is not found in young Secondary Forest.

(ii) Picralima nitida Th.& Hél. Dur.

SYNONYMS. P. klaineana Pierre P. macrocarpa A.Chev.

VERNACULAR NAMES. Akuamma (F,W). Kakooli (Nz). Kanwini (Ash,T)

A small tree with a height of about 30 ft. and 1-2 ft. G.B.H. The bole is short and may not be more than 12 ft. long. It is usually bent slightly. The dense crown is low and spreading. The bark is dark grey to blackish, finely rough and thin. The yellow-brown slash is granular and the latex is milky white. The pale yellow wood is hard, heavy (68 lb. per cu. ft. air dry), close grained and of fine texture. It is used for native shuttles, combs and carpenters' planes. The name Knawini means to taste bitter, and refers to the bitter concoctions made from the leaves and fruits which are said to cure malaria.

BOTANY. The leaves are opposite, oblong-elliptic to oblong, about 5 in. long and 1½ in. broad, entire, acuminate and broadly cuneate. The lamina is glabrous, dull green above and lighter below. The numerous fine nerves are just visible. The midrib is raised below and the slender petiole is about ½ in long. The yellow-white flowers (about 1½ in. long) are borne in terminal inflorescences. The fruit consists of twin, large, ellipsoid yellow mericarps, each being up to about 6 in. diameter. One of each pair may be bigger than the other. There are about 75 seeds, embedded in a fairly hard pulp, to each fruit. The seed is about 1 in. long and ½ in. broad, golden brown, flattened and irregularly shaped.

PHENOLOGY. The tree is evergreen. Flowering is from March to July. The fruits are to be seen during most months of the year, but are not ripe till March and April. The heavy fruits fall to the ground, where they rot or are eaten by animals, and so the seeds are liberated.

SEEDLING. Germination is epigeal. The brown hypocotyl is about 3½ in. long. The cotyledons expand to become foliaceous. They are broadly elliptic, about 2 in. long and 1½ in. broad, dark green, sessile, and are veined from the base. The first pair of leaves is borne about 1 in. above the cotyledons. The leaf is oblong-lanceolate, about 1½ in. long and 0.4 in. broad, acute, cuneate and with a short petiole.

DISTRIBUTION & SILVICULTURE. P. nitida is a shade bearer and is found in the understorey of the Moist Semi-Deciduous Forest. Its occurrence may be described as rare, although locally it may be semi-gregarious. It avoids very moist situations.

NATURAL REGENERATION. Prolific regeneration is to be found in groups under or hear the mother trees. Each group may contain 50 or more seedlings and represents the product of a fruit. Because of the young seedlings being so close together, there is a high mortality, and few survive. Seed dispersal is dependent on animals, but from the little regeneration that is seen away from mother trees, it is apparently not effective.

ARTIFICIAL REGENERATION. The germination period is about 47 days and the plant percentage 72 at a year. In creating a small plantation in Kumasi, stumped plants were used. Growth has been steady, but very slow. At the end of 12 years the trees were 12-20 ft. high and 4-11 in. G.B.H.

(iii) Picralima umbellata Stapf

SYNONYM. Polyadoa umbellata Stapf

VERNACULAR NAMES. Akuamma (F,W). Kakooli (Nz). Kanwini (Ash,T).

This tree is similar to P. elliotii, but differs from it in having a broader leaf and in having a wider distribution in the High Forest Zone, where it is uncommon. The leaf is oblong-elliptic, about 5½ in. long and 2¼ in. broad, entire, broadly acuminate and broadly cuneate. The midrib is raised below and the nerves are fine. The slender petiole is about 0.4 in. long.

BIGNONIACEAE.

A family containing small trees with showy, zygomorphic flowers. The leaves are pinnate, exstipulate and opposite, and the fruits are usually follicles.

Kigelia DC. and Stereospermum Cham. are represented in the High Forest and Savannah-Woodland; Markhamia Seem. is found in the transition belt between these two formations; and Newbouldia Seem. belongs to the High Forest Zone, although it is occasionally seen in Derived Savannah-Woodland.

SPATHODEA Beauv.

Spathodea campanulata Beauv.

VERNACULAR NAMES. Adatsigo (E). Akuakuaninsu (T). Kokooanidua (Ash). Kokoonsu (Ash,T). Osisiriw (Ash).

A small to medium sized tree. In the open its maximaum height is about 50 ft. and a G.B.H. of about 6 ft. In the forest it may reach 80 ft. high. The bole is usually short and badly shaped, and is very fluted at the base. In old trees, small buttresses may develop. The crown is rounded and spreading. The bark is thin, light brown, dry and rough, and has many vertical cracks. The slash has a green outer layer and under this it is white which rapidly discolours to a light green-grey. The wood is soft, light and white or slightly yellow at first, but becomes brown in time. In transverse section, large vessels are visible, and with a hand lens many fine medullary rays can be seen. The wood is said to be used in the making of blacksmiths' bellows.

BOTANY. The opposite leaves are imparipinnate and exstipulate. The leaf consists of 5-7 pairs of opposite leaflets and a terminal one. The leaflet is oblong-elliptic, about $4\frac{1}{2}$ in. long and 2 in. broad. entire, broadly acuminate, unequal at the base, dark green above and light green below. There are glandular swellings at the base of the lamina - usually a pair. The midrib and nerves are yellow and raised, and are very slightly pubescent. The venation is reticulate. The short, thick petiole is about 0.3 in. long. There are conspicuous lenticels on the rhachis, and its base is swollen. The large, red, hermaphrodite flowers are orange coloured inside. The green calyx is about 2 in. long and is split on theposterior side. It is ribbed and tomentellous. There are 5 petals, about 3 in. long and 4 stamens with orange filaments arising from about $\frac{1}{2}$ in. above the base of the corolla. The extruding style has a 2 lipped stigma. The flower buds are curved and contain a red sap (thus the name kokoonsu which means red water). The fruit is an erect follicle

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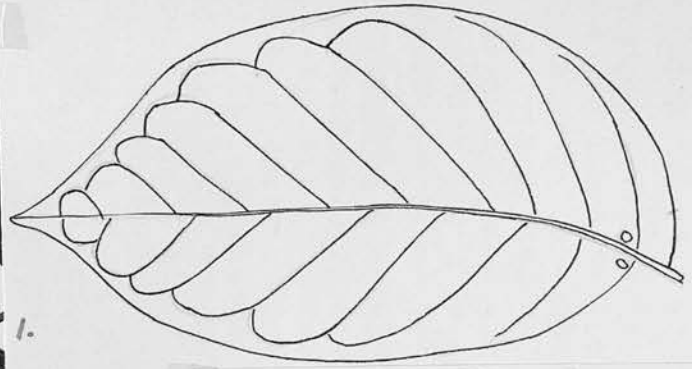

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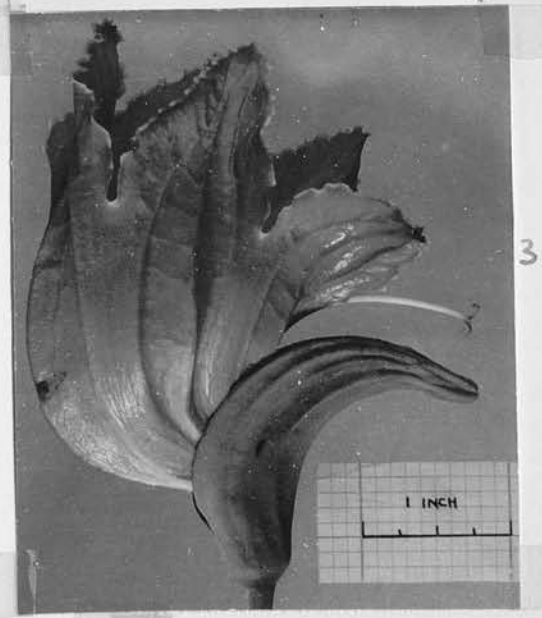


3.

4.

5.

Spathodea campanulata. 1. Leaf. 2. Leaflet x 1.
3. Flower. 4. Bole. 5. Tree.

up to 8 in. long and contains many brown seeds, each of which is surrounded by a transparent, membranous wing. The branches are grey and have many lenticels.

PHENOLOGY. The trees are deciduous from October to March, but some are leafless for a shorter period. Flowering is from September to December, and the crowded, terminal, red flowers are very conspicuous. The first trees to flower are usually those in the more open conditions beyond the High Forest proper. The fruits are ripe from the middle of February to April. They open on the trees and the seed is wind distributed.

DISTRIBUTION & SILVICULTURE. Spathodea occurs in the Moist Semi-Deciduous Forest but is apparently absent from the Rain Forest. Its greatest frequency is along the northern edge of the High Forest, in Togoland and on the southern limits of the Moist Semi-Deciduous Forest. It does well in Secondary Forest, and within its range it is commonly seen on the waste land around towns. It prefers well drained situations. Spathodea is a light demander and a coloniser in clearings and other open spaces. But it is found as individuals and not growing gregariously. This may be due to the fact that the germination capacity of the seeds is very poor.

DISEASES. Insects attack the bark and cause it to drip. A borer may cause the death of the leading shoot. Sometimes the new shoots produced after the death of the leader are attacked, and so height growth may be seriously retarded.

BOMBACACEAE.

This family of trees, often large ones, is represented in the Gold Coast by three genera. Adansonia digitata L. is the grotesque baobab found in the Savannah-Woodland, particularly in the north, and in the Coastal Grassland east of Accra.

The leaves are usually palmate and exstipulate. The flowers are hermaphrodite and often 5-merous. The fruit is a capsule and the seeds are usually embedded in silky hairs.

GENERA. 1. Bombax L. 2. Ceiba Plum. ex Mills

1. BOMBAX L.

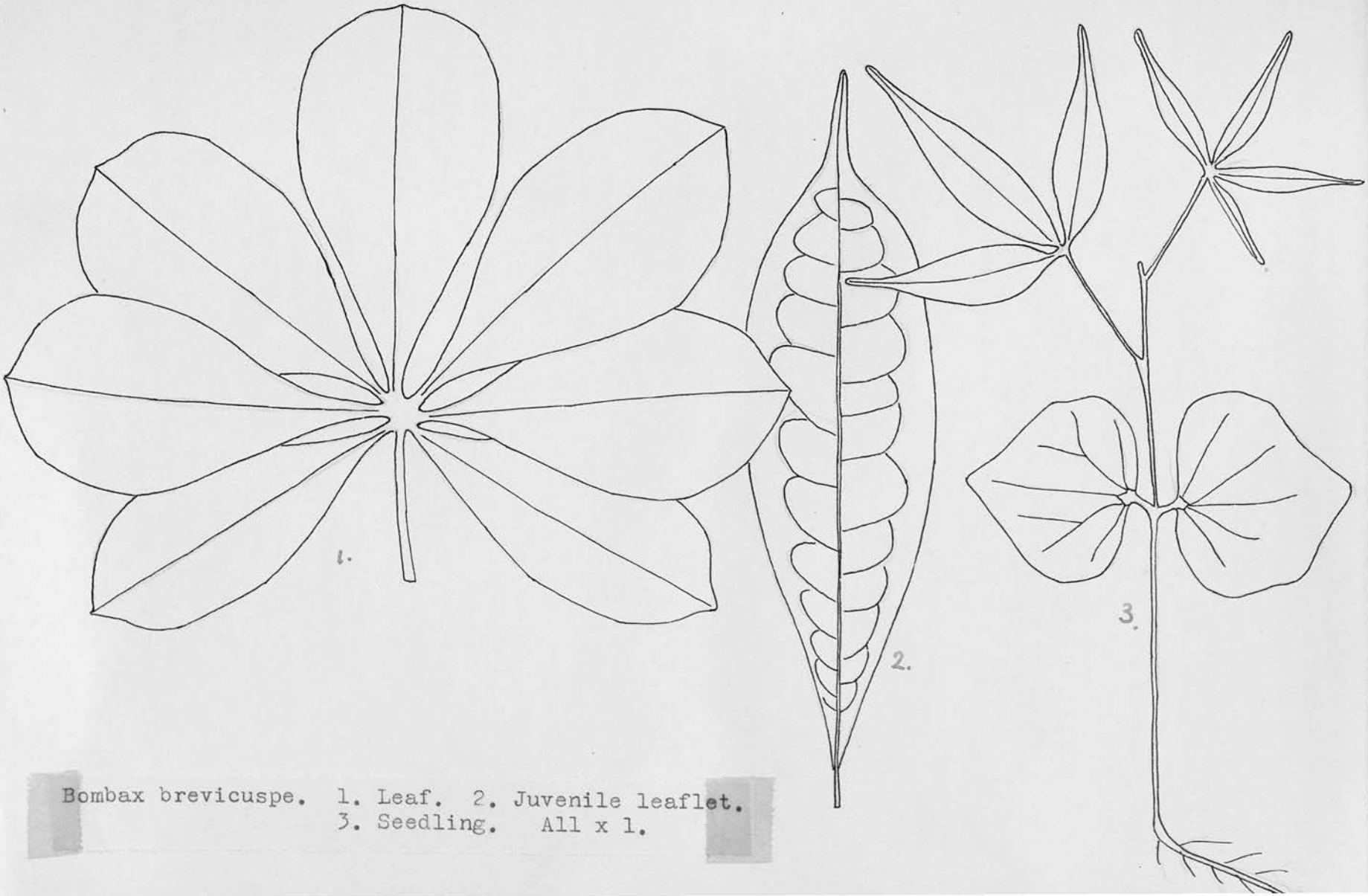
Trees of this genus are usually referred to as the Red Silk Cotton on account of their flowers. But one Gold Coast species has white flowers. There has been quite a lot of confusion in specific identifications and it is the present writer's opinion that there are two species in the High Forest Zone - B. brevicuspe Sprague and B. buonopozense P.Beauv. There are apparently varieties of the latter and the differences are shown in the leaflets. Aubréville calls the species found in the Guinea Savannah-Woodland B. costatum Pellegr.& Vuillet. There are very good reasons for doing so.

SPECIES. (i) B. brevicuspe Sprague (ii) B. buonopozense P.Beauv.

Bombax brevicuspe Sprague

VERNACULAR NAMES. Ekuba (Nz). Engyakobini (Nz). Kuntunkuni (Ash,T). Onyinakoben (T,W).

A tall tree, up to 160 ft. high, or more, and with a large girth, often exceeding 15 ft. G.B.H. The bole is straight, long and cylindrical, and without spines. The buttresses are small and low. The crown is rounded and is not dense; it is made up of fairly thin (for the size of the tree), whorled, horizontal branches, which do not extend very far from the bole. The bark is grey and fairly smooth, and the lenticels are not prominent. The slash is thick and soft; it is bright red with white vertical stripes running through it. These stripes become brown very rapidly on exposure. In fact, the whole of the exposed slash becomes a dull saffron brown before long. The white sapwood discolours to light brown. The wood is yellowish and is not durable. The bark is used in preparing the saffron dye for funeral cloths, and this gives the tree the name Kuntunkuni, which is the name of these mourning cloths. (See Lannea welwitschii). The floss around the seeds yields a reddish-brown kapok.



Bombax brevicuspe. 1. Leaf. 2. Juvenile leaflet.
3. Seedling. All x 1.

BOTANY. The leaf is digitately compound and there are normally 7 sessile or subsessile leaflets. The petiole is about 1¼ in. long. The leaflet is obovate, about 2½ in. long and 1½ in. broad, entire, broadly apiculate, and the base either cuneate or attenuated. The midrib is slightly raised above; below it is prominently raised and often has a red tinge. The green, caducous stipules are triangular - about 0.6 in. long and 0.25 in. broad at the base. In the young leaf the dark green slender petiole may be 4½ in. long; the leaflet is oblanceolate, up to 5½ in. long and 1¼ in. broad, entire, with an acumen about ¾ in. long and attenuated base. The lamina is dark green above and dull, light green below. All parts of the leaf are glabrous. The flowers are about 1½ in. long and the petals are white. There are numerous stamens. The fruit is a 5 valved capsule up to 3 in. long, which contains seeds embedded in floss.

PHENOLOGY. The tree is deciduous from December to March and the length of the leafless period depends on whether flowers are being produced. The deep red flush of new leaves comes earlier if there are no flowers. Flowering begins in November and is usually over by the end of January. The pendulous fruits may be seen on the tree from March to May. Many fall unopened; dehiscence on the tree is more likely if atmospheric conditions are dry. However, even then, it is noticeable how many fruits do fall intact.

SEEDLING. Germination is epigeal. The hypocotyl is glabrous, green and about 2½ in. long. The cotyledons expand and become broadly ovate, about 1.25 in. long and 1.4 in. broad, with a petiole 0.15 in. long, which is flattened above and below; the lamina is dull, dark green above and lighter, dull green below, irregularly and slightly wavy, and palmately veined. The stem is green and glabrous and the leaves are alternate. The first leaf is trifoliate and leaflets are added in succeeding leaves until there are seven. The young leaflet is lanceolate, about 1½ in. long and 0.4 in. broad, entire, with a long acumen, narrowly cuneate and sessile. The midrib is raised above and below. The slender green petiole is about 1 in. long. All parts of the seedling are glabrous.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone, but compared with B. buonopozense it is rare. It is a light demander and does well in Secondary Forest. It is never found in quantity in any one area, and this is likely to be due to the poor distribution of the seed.

FIELD NOTES. This species is easily recognised from B. buonopozense and Ceiba because of the bole having no spines, and is unique amongst Bombax spp. in having white flowers. These flowers differ from those of Ceiba in having many stamens.

(ii) Bombax buonopozense P.Beauv.

SYNONYM. Gossampinus buonopozensis Bakh.

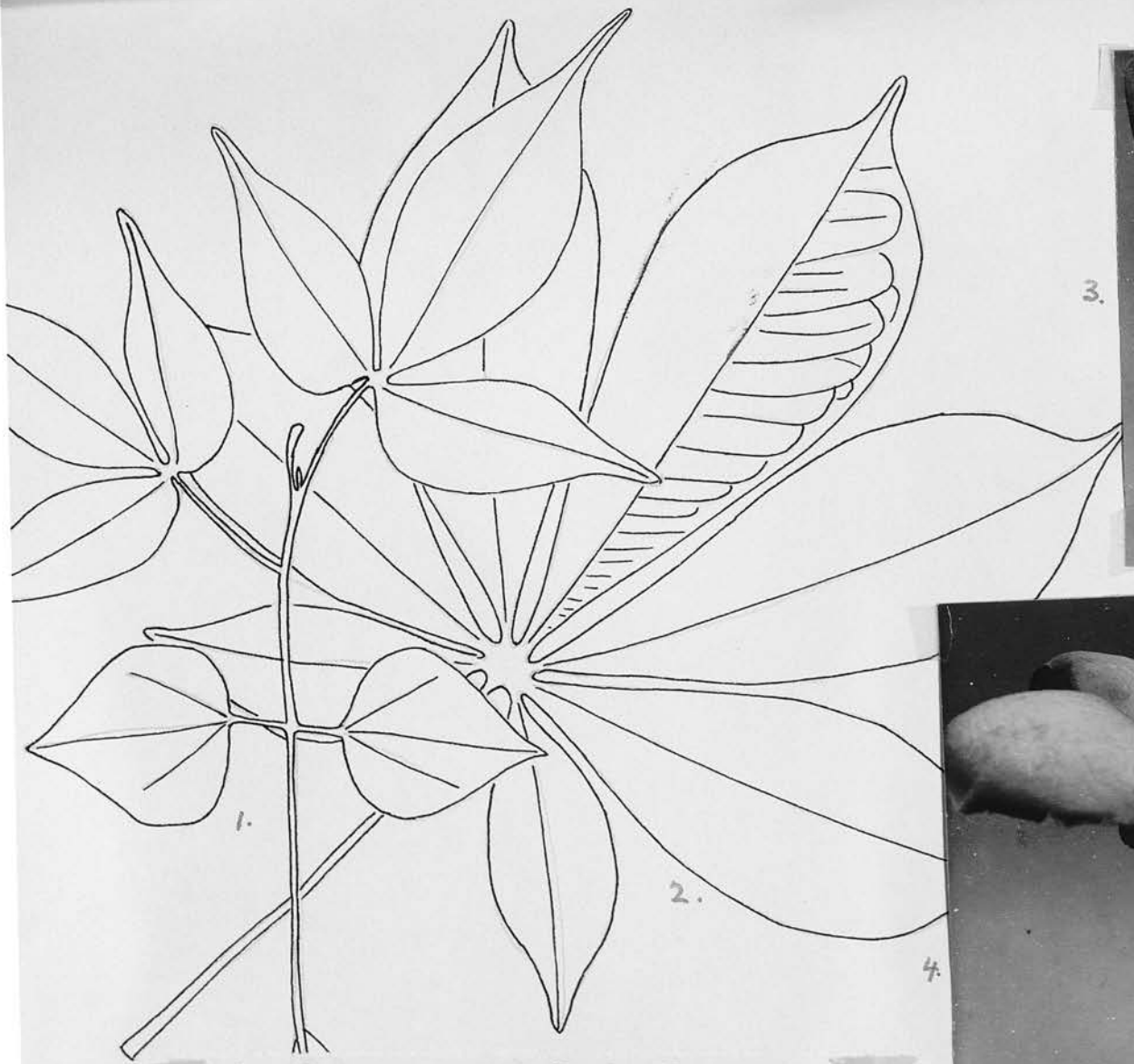
VERNACULAR NAMES. Akata (T,W). Akonkodie (Ash,F,T). Eku (T). Ekuo (Ao).

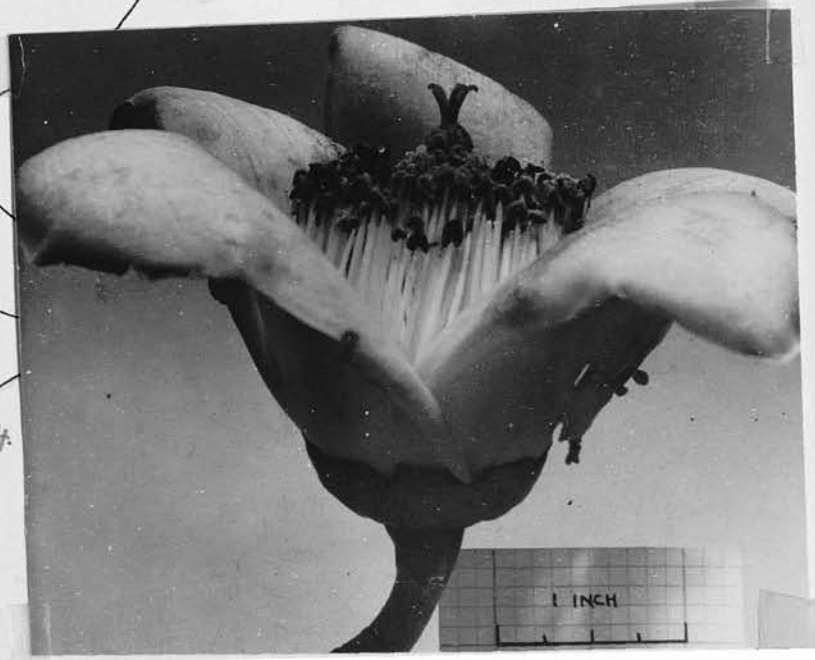
A tall tree, up to about 160 ft. high and a girth B.H. of 15 ft. or more. The buttresses are large. There are spines on the cylindrical bole and their number and size vary with the age of the tree. On young specimens the spines have large conical bosses, and are very numerous. In middle sized trees they tend to form vertical rows and may be absent in old trees. The crown is rounded and quite big. The branches are big and whorled; the lower ones are horizontal and the uppermost inclined upwards. The bark is grey and the slash is very thick and soft, and is a mixture of pink and white, and contains brown, irregular flecks. The white sapwood darkens to a light brown on exposure, and in it faint ripple marks can be seen. The yellow wood may be reddish at the heart. It is not durable and has a coarse texture. The large vessels are easily visible.

BOTANY. The digitate, glabrous leaf has usually 5 or 7 leaflets and the petiole is about 5 in. long. The leaflet is obovate, about 4 in. long and 1½ in. broad, or smaller, entire, broadly apiculate to acuminate, with an attenuated base, and it may be bub-sessile or have a short petiolule. The midrib is slightly raised above and prominently raised below. The scarlet flower is about 2½ in. long and is borne erect. The green sepals are fused into a ring which is used in a children's game called akonkodie (see vernacular names). The 5 petals are contorted. The stamens are arranged in 5 bundles and each bundle contains about 25. The style with its 5 stigmata protrudes beyond the anthers. The ovary is superior. The fruit is a woody capsule, about 4½ in. long, 5 valved, and contains numerous black seeds embedded in greyish-white floss.

PHENOLOGY. The tree is deciduous from November to March, and the red, conspicuous flowers are to be see from November to January. The pendulous fruits are available from March to May, and usually burst on the tree. The seeds are wind distributed.

SEEDLING. Germination is epigeal. The light green, glabrous hypocotyl is about 2 in. long. The cotyledons become foliaceous, cordate in shape, about 1 in. long and broad, and with a petiole about 0.3 in. long. The leaves are alternate - the first being borne about 1 in. above the cotyledons. The first leaves are trifoliate, with lanceolate, entire leaflets, and later ones digitate. The stipules are acicular. The seedling is glabrous. There are spines on the stem.





Bombax buonopozonse. 1. Seedling x 1.
2. Leaf x 1. 3. Flower buds. 4. Flower.

DISTRIBUTION & SILVICULTURE. B. buonopozense is found throughout the High Forest Zone, in the Derived Savannah-Woodland and in the Coastal Scrub and Grassland. It is not common in the Rain Forest. It is a strong light demander and is common in Secondary Forest as long as soil conditions are not too moist.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Kakum	150	25	17	8	5	5
Onuem-Nyamibe Shelterbelt	62	14	7	2	4	1
Bobiri	94	2	1	-	1	2
Odomi River	43	6	4	2	2	1

NATURAL REGENERATION. This is prolific and is to be seen in abundance in openings in the forest, along roadsides and in clearings such as new farms. Although abundant, it is less common than Ceiba. Seed dispersal is efficient, and germination takes place in about 12 days. Growth, where there is sufficient overhead light, is very fast, and a height of 10 ft. may be achieved in the first two years. Rapid growth continues for some years, and the annual height increment is usually 3-5 ft. in youth.

PATHOLOGY. B. buonopozense is a suspected alternative host of cacao viruses causing the swollen shoot disease of cacao trees.

2. CEIBA Plum. ex Mills.

Ceiba pentandra Gaertn.

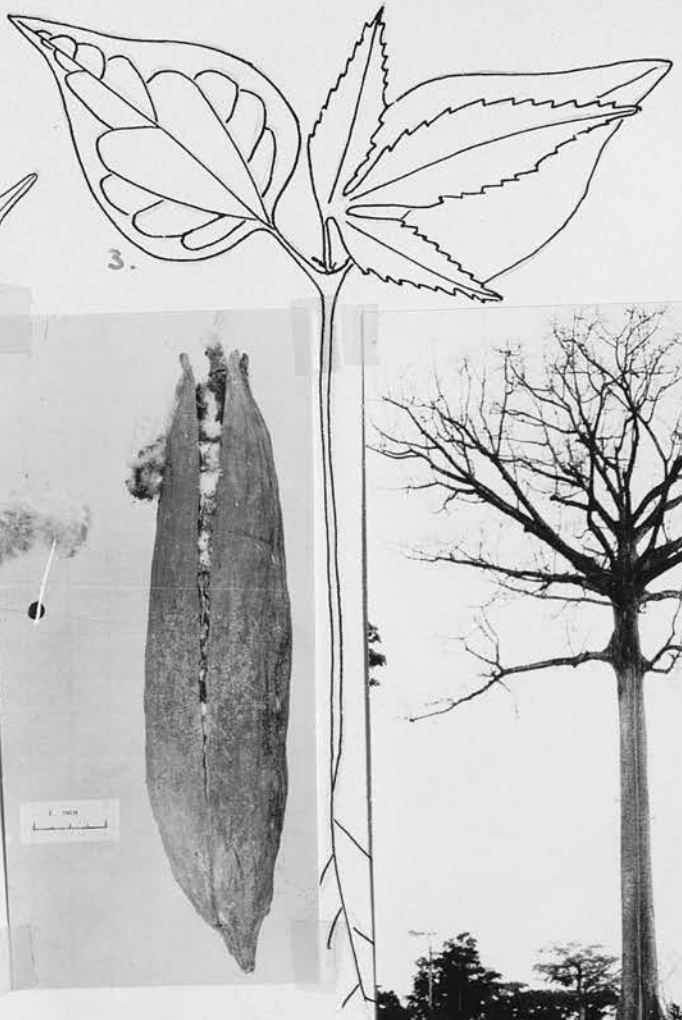
SYNONYM. Eriodendron anfractuosum DC.

VERNACULAR NAMES. Ekile (Brong). Enya (Ao,S). Enyenna (Nz) Leno (Ad). Onyina (Ash,F,T). Vuti (E).

Commonly called the Silk Cotton or Cottonwood.

TRADE NAMES. Ceiba, or sometimes Cottonwood.

Ceiba is the biggest tree in the Gold Coast, both in height and girth. It may reach close to 200 ft. high, and girths of 30 ft. are sometimes exceeded. The buttresses are huge; they may extend 25 ft. up the bole and cover a large area on the ground. The crown is large and rounded, and the branches forming it are huge. Branches of younger trees are more or less horizontal. The bole is cylindrical and in the younger stages it bears prickles. The bark is light grey and fairly smooth. The slash is hard, light brown immediately below the bark, then



Ceiba pentandra. 1. Leaf x 1.
2. Fruit. 3. Seedling xl.
4. Tree.

pink to pink-brown and darkening to a red-brown on exposure. Vague ripple marks can be seen in the light brown sapwood, which also shows somewhat glistening white diamond shaped markings against a brown background. The wood is white to greyish, light (17-28 lb. per cu. ft., air dry), not durable, liable to stain, has a coarse texture and is cross grained. It is not used except for sea-going canoes by the Nzimas. Bowdich ( ) in 1817 stated that doors of houses in Kumasi were made from the buttresses of this tree. The floss around the seeds gives the Kapok of commerce.

BOTANY. The leaf is glabrous and digitate, being composed of 5, 7 or 9 leaflets. There are usually 5 leaflets in the mature form. The petiole is slender and up to 6 in. long. The leaflet is sessile, narrowly oblong-lanceolate, about 4 in. long and 1¼ in. broad, entire (serrate on the young plant), acuminate and cuneate. The white flowers are about 1 in. long. There are 5 small, green sepals, 5 white petals covered with a dense mat of silky hairs on the outside and with small appendages on the inner side at the base, 5 exserted stamens and one style. The fruit is a dehiscent, black, ellipsoid, pendulous capsule of 5 valves and is about 6 in. long. In it are numerous black seeds in a grey-white floss.

PHENOLOGY. The tree is deciduous from October to March and flowering takes place from October to January. The petals, sepals and style fall complete. The period of deciduousness is directly related to the sexual behaviour of the individual tree. If flowering is to take place, it is deciduous for a short period. It may well be that one part of the tree is going to flower, in which case it will be left leafless until flowering is over, while the other parts of the crown will produce a flush of new leaves after only a short deciduous period. Although the flowering times are fairly regular for the species, deciduousness is not. It is not unusual to find a few trees losing their leaves in August and producing new ones soon afterwards. The leaves are a bronze colour at first but rapidly become green. Fruits are available from February to April. It appears to be a varietal difference whether the majority of the fruits burst on the tree or fall to the ground unopened. Plentiful seed is produced.

SEEDLING. Germination is epigeal. The red hypocotyl is about 2½-3 in. long. The cotyledons become foliaceous; they are cordate, about 1½ in. long and 1 in. broad, veined, and the petioles are about 0.4 in. long. The primary leaves are glabrous and alternate; the first are trifoliate and later ones are digitate. The leaflet is oblong-lanceolate, serrate, acuminate, cuneate and sessile. The stipules are caducous.

DISTRIBUTION & SILVICULTURE. C. pentandra is spread throughout the Gold Coast. It is likely that those found in the Savannah-Woodland are now an environmental variety. Their capsules, at any rate, differ somewhat from those belonging to the High Forest Zone. It is a strong light demander and is common in Secondary Forest. Relic trees are to be found in and around most towns in the Forest and Coastal Zones, and some of them must be very old. This species appears to be less common in the Rain Forest than in the Moist Semi-Deciduous Forest. It is almost indifferent to soil conditions, and although it does not grow in freshwater swamps, it will grow along their margins. It has been suggested that this tree has been introduced from Tropical America. If this is the case, then it must have been a long time ago for it is thoroughly acclimatised in the Gold Coast.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet 3-5	5-7	7-9	9-11	11-+
Kakum	150	12	13	7	3	10
Asenanyo	77	1	4	1	2	13
Bobiri	94	1	-	-	1	22
Northern Scarp (East)	100	30	14	14	13	8
Odomi River	43	6	8	8	6	6

NATURAL REGENERSTION. Regeneration is widespread and prolific. From April onwards, Ceiba seedlings are to be seen in open places in the forest, along the sides of roads and paths, in farmland and on almost any wast space. Because of the tall trees, the seeds are liberated from a good height, and it is evident that they travel far. Their viability is high and germination takes place in about 12 days. Growth is very rapid, and in the sapling stage the annual height increment may be anything up to 6 ft., and in some cases more, where there is plenty of overhead light.

PATHOLOGY. C. pentandra is considered to be an alternative host of the virus producing the Swollen Shoot disease of cacao. It is also a host of the Cotton Stainer.

FIELD NOTES. Bombax buonopozense and Ceiba pentandra are sometimes confused. The following are useful diffenerences to note between them:

	B. buonopozense	C. pentandra
Hypocotyl	~~Green~~	Red
Seedling leaflet	Entire	Serrate
Juvenile "	"	"
Mature "	"	Entire
" "	Obovate	Oblong-lanceolate
Flowers	Red	White
Slash	Soft	Hard

BORAGINACEAE.

This family is mainly herbaceous, with alternate, exstipulate and pubescent leaves. The flowers are regular and usually 5-merous, with a bi-carpellate superior ovary. The family is poorly represented in the forest flora of the Gold Coast, and only one genus will be considered here.

CORDIA L.

A genus of shrubs and trees.

SPECIES. (i) C. millēnii Baker (ii) C. platythyrsa Baker

These two species are not separated by the natives; in fact, they were at one time confused botanically.

(i) Cordia millenii Baker

SYNONYM. C. irvingii Baker (partly).

A medium sized tree of the Moist Semi-Deciduous Forest and very similar to C. platythyrsa. The chief difference lies in the leaves, These are more or less orbicular, about 4½ in. long and 4 in. broad, or bigger, entire or vaguely undulate, often cordate at the base, but sometimes rounded. The leaf is 3-5 nerved from the base and the tertiary nerves are more or less parallel with each other. All the nerves are raised below and are prominent. The venation is reticulate. There are scant tometose hairs on the underside of the lamina. The petiole is about 2 in. long and is channelled above.

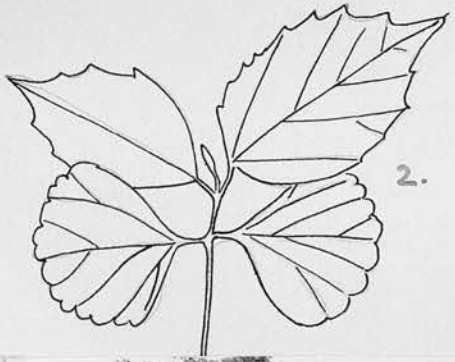
(ii) Cordia platythyrsa Baker

SYNONYMS. C. candidissima A.Chev. C. irvingii Baker (partly)
C. platyphylla A.Chev.

VERNACULAR NAMES. Achaboa (S). Tweneboa (Ash,T).
Twenedoleye (Nz). Twenedua (F).

A medium sized tree, about 80 ft. high and up to 10 ft. G.B.H. The bole is cylindrical, but the upper part is often leaning slightly. Short root spurs are developed. The crown is fairly thin, spreading and flattened on top. The bark is light brown, with long, thin, flaky, dry scales. The slash is yellow-white and fibrous and discolours to brown; the sapwood becomes green when cut with an iron or steel implement. The bark of the young tree is smooth and green and contains numerous lenticels. The sapwood is white and the heart brown. The wood is light, soft, close grained and easily worked. In transverse section, growth rings and many intermittent bands of parenchyma are visible. With a hand lens, the fine medullary rays can be

1.



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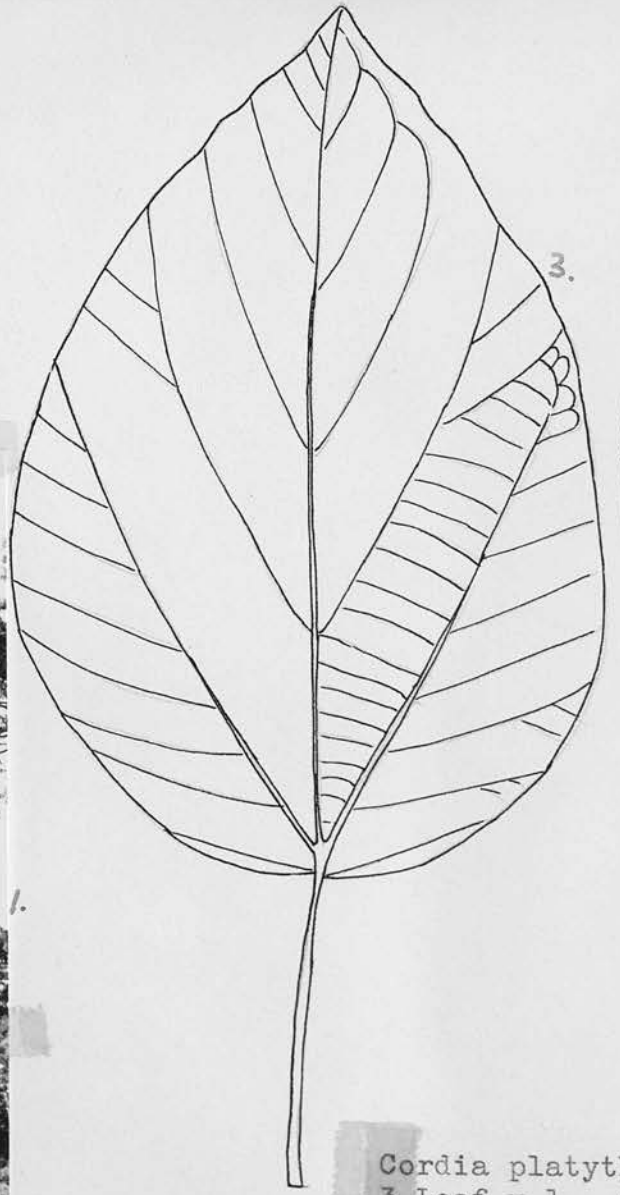

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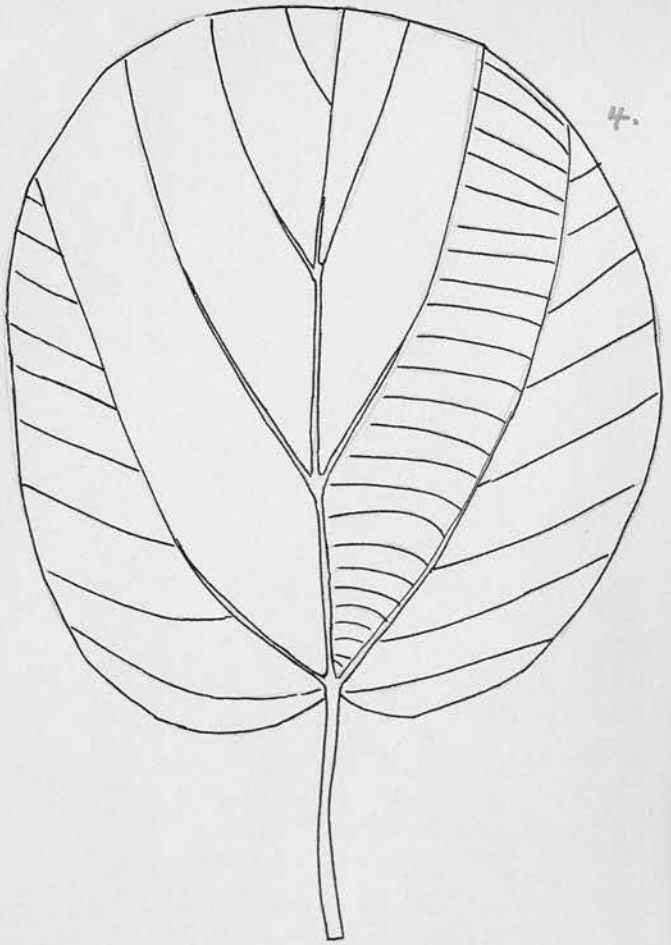


4.

Cordia platythyrsa. 1.Tree. 2.Seedling x 1.
3.Leaf x 1. C. millenii. 4.Leaf x 1.

seen. The wood is occasionally used for roofing shingles, but its almost exclusive use is for making the large native drums, from which it derives its names.

BOTANY. The leaf is ovate, about 5 in. long and 3 in. broad, entire or vaguely undulate, acute, rounded at the base, with 3 basal nerves. The tertiary nerves are more or less parallel with one another. The nerves are raised below and are prominent. The slender petiole is about 2 in. long. The petiole and underside of the lamina are densely tomentose, and the upperside is weakly villose. There are no stipules. The small yellow flowers are cymose. The fruit is a narrow, ellipsoid drupe, about $1\frac{1}{2}$ in. long, containing 4 nutlets.

PHENOLOGY. The tree is leafless in February and March. The flowers are produced in March, immediately after the flush of leaves, and are over by about the end of April. Ripe fruits are available from June to August.

SEEDLING. Germination is epigeal. The dark brown, slender hypocotyl is about $1\frac{3}{4}$ in. long and bears a few white hairs. The cotyledons are foliaceous, fan-shaped, and markedly notched at the apical edge. The lamina is about $\frac{3}{4}$ in. long and almost 1 in. broad, and the slender petiole is about 0.15 in. long, and bears white hairs. The primary leaves are alternate. The first is borne 0.2 in. above the cotyledons. There are white villose hairs on the shoot and petioles, and the margins of the leaves are ciliate. The second leaf is dull green, entire, elliptic, about $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. broad, markedly dentate, each tooth being mucronate. It is acuminate, with a small mucron, and the base is more or less rounded.

DISTRIBUTION & SILVICULTURE. C. platythyrsa is found in the Closed Forest and Secondary Forest, but is rare. Natural regeneration is seldom seen. Under test conditions, the germination period is 17 to 32 days, and 77% germination has been obtained.

BURSERACEAE.

A family of trees and shrubs which usually have compound, alternate leaves, scented bark, a resinous exudation and unisexual flowers. It is represented in the Gold Coast by a large tree and the small trees of Pachylobus Don.

CANARIUM L.

Canarium schweinfurthii Engl.

SYNONYMS. C. occidentale A.Chev. C. velutinum Guill.

VERNACULAR NAMES. Amoukyi (W). Bediwuna (Ash,T). Eyere (Nz). Kantankrui (S). Kurutwe (W).

TRADE. Canarium.

A large tree of the emergent canopy, often reaching 150 ft. high, and sometimes with huge girths. One in the Yoyo F.R. measured 29 ft. 6 in. G.B.H. Two felled trees gave these measurements:

Girth B.H.		Bole length.		Height.	
ft.	in.	ft.	in.	ft.	in.
11	10	78	3	156	9
10	7	78	3	152	8.

The bole is straight and cylindrical. There are no true buttresses, but root spurs about 3 fr. high are developed in the older trees. Large surface roots are formed. The crown is light, but big and spreading, and is composed of heavy branches, with the leaves grouped at the ends.. The bole is covered with thin, light grey scales, but in the younger stages it may show conchoidal markings. Earlier than this the bole is fissured vertically. The slash is hard, slightly fibrous, pinkish-brown and scented. There is a slow, slight exudation of a clear gum with a smell similar to turpentine. On hardening, the gum becomes yellowish and opaque. The sapwood is a whitish- grey. At first the heart is pink but darkens to a light brown. It is light (28-33 lb. per cu. ft. seasoned) but strong, comparatively soft, fibrous, with an interlocking grain, but easy to work, scented and lustrous. In the Gold Coast the timber is only occasionally used in carpentry. The gum is used in pomades and native medicines, and for mending broken earthen pots. The bark is said to provide an aphrodisiac.

BOTANY. The alternate, large, imparipinnate leaves are up to about 15 in. long. There are about 10 pairs of opposite or subopposite leaflets and a terminal one. The leaflet is entire, oblong-lanceolate, about 4 in. long and 1½ in. broad or bigger, acuminate, slightly cordate at the base, faintly pubescent, and with a very short petiole which is flattened above. The

Canarium schweinfurthii. 1. Seedling. 2. Leaflet. 3. Fruit. 4. Seed. All x 1. 5. Tree. 6. Bole.

midrib and nerves are raised below. The nerves are regularly looped close to the margin. The pubescent rhachis is more or less winged at the base. The young shoot is stout and is covered with a dense ferruginous pubescence. The scars left by the petiole bases are large and prominent. The tree is dioecious. The inflorescence of small flowers is axillary at the ends of the branches. The male flower has 3 green sepals, 3 white petals and 6 stamens. The female has, in addition to the perianth, 6 staminodes and a superior ovary of 3 carpels, with 2 ovules in each loculus. The fruit is a drupe, plum red when ripe, about $1\frac{1}{4}$ in. long and $\frac{1}{2}$ in. diameter, containing a 3-angled stone, which may also show 3 minor ribs. There are 3 kernels inside, but it is usual for only one to germinate.

PHENOLOGY. The deciduous period is from November to January, but the individual tree is normally leafless for only a short time. The flush of new leaves is red. Flowering takes place from March to May, and the ripe fruits are ready in August and September, when they may be collected below the mother trees.

DISTRIBUTION & SILVICULTURE. Canarium is never common, but is found throughout the High Forest Zone and in the Riverain Forest of the southern Savannah-Woodland. It is more common in the Antiaris-Chlorophora Association then elsewhere. The tree is a strong light demander from the seedling stage upwards. It grows vigorously and does well in Secondary Forest. It prefers a well drained soil and is often found on slopes.

The following frequencies are from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+-
Ankasa River	120	1	1	1	2	3
Pra-Suhien I	203	3	1	2	-	1
Yoyo	569	70	25	5	1	1
Atewa Range	573	32	32	6	8	5
Onuem-Nyamibe Shelterbelt	62	-	-	-	1	-
Amama Shelterbelt	109	40	12	9	6	2

SEEDLING. Germination is epigeal. The deeply lobed cotyledons are conspicuous. They are about 3 in. long and broad and shortly petiolate. The cotyledon divides into three at the base and the two lateral parts are divided into two for most of their length. The glabrous hypocotyl is about 3 in. long. The stem and leaves are covered with villose hairs. The first two leaves are opposite and simple; the remainder are spiral. The third leaf is simple, elliptic, about $3\frac{3}{4}$ in. long and $1\frac{3}{4}$ in. broad, serrate, acuminate, with a slightly cordate base, and a tomentose petiole about $1\frac{1}{4}$ in. long, slightly swollen at the base and less so at the apex. The lamina is dull green. The midrib

and nerves are raised below. A change in the leaves takes place about the time the sixth is formed. It may be bifoliate and the seventh may show indications of becoming imparipinnate.

NATURAL REGENERATION. The seed normally lies dormant until the beginning of the rainy season, i.e. to April-May. In June, the seedlings, conspicuous because of their diagnostic cotyledons, are to be seen where the overhead shade of the forest is not too dense, and on felling sites and exploitation tracks, and in farm clearings. But never is the regeneration found in quantity. The hornbills seem to be responsible for much of the seed dispersal. It is possible that small animals, such as squirrels, may help in this. Where there is plenty of overhead light, the seedling will grow quickly. The sapling is stout, straight and without branches.

ARTIFICIAL REGENERATION. Germination takes about 3 weeks, and the plant percentage at the end of 6 months is about 85. Growth is rapid and at the end of a year the plants are from 1 ft. 6 in. to 4 ft. 6 in. high. They can be planted either as stumped or stripped plants.

FIELD NOTES. The tree may at first be mistaken for Entandrophragma utile because of the appearance of the bole and the crown. The absence of buttresses and the characteristically scented slash of Canarium are useful distinctions.

CAESALPINACEAE.

This large family is made up mainly of trees and shrubs. The leaves are usually pinnate (sometimes bipinnate). The flowers are zygomorphic and made up of 5 sepals, 5 petals, usually showy, 10 stamens and a unilocular ovary. The fruit is typically a pod, which in some cases is indehiscent.

Members of this family are found throughout the Gold Coast. Genera not found in the High Forest Zone are Bauhinea L., Burkea Hook., Cassia L. (as a tree), Isoberlinia Craib & Stapf, Piliostigma Hochst. and Tamarindus L.

GENERA. 1. Afzelia Sm. 2. Berlinia Soland. 3. Bussea Harms 4. Cynometra L. 5. Daniellia Benn. 6. Dialium L. 7. Distemonanthus Bth. 8. Erythrophleum Afz. 9. Guibourtia 10. Macrolobium Schreb.

1. AFZELIA Sm.

SPECIES. (i) A. africana Sm. (ii) A. bella Harms

(i) Afzelia africana Sm.

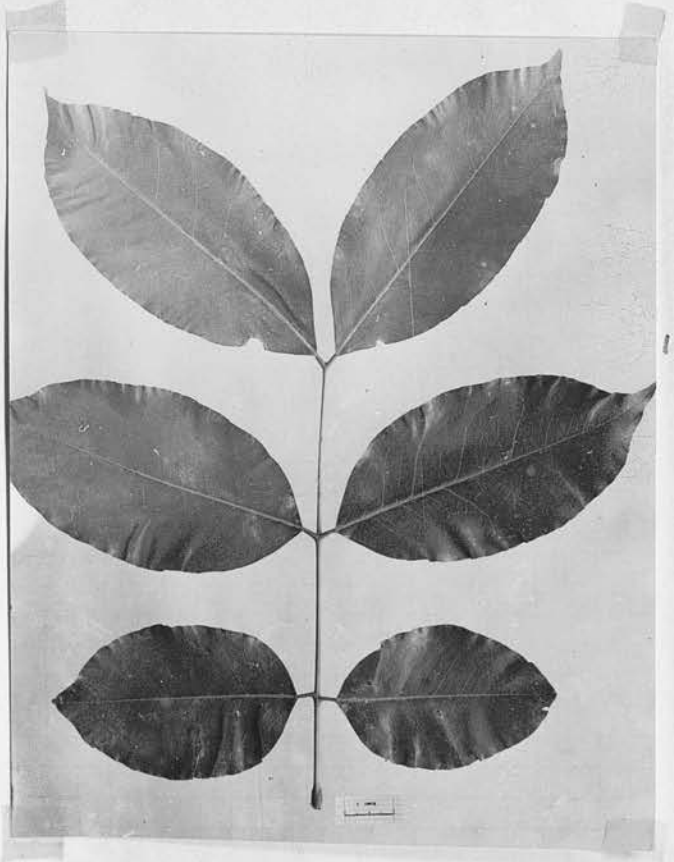
SYNONYMS. Afrazelia africana (Smith) Pierre. Pahudia africana (Smith) Prain.

VERNACULAR NAME. Papao (Ash,T).

TRADE NAME. Afzelia.

A tree which may be about 50 ft. high in the open or up to 90 ft. high in closed forest. The bole is never straight, and although short, its girth may reach about 8 ft. B.H. There are short buttresses in the older trees. The open crown is spreading and irregular in shape, and the branches are heavy. The bark is light coloured and is covered with big, irregular scales, which may leave conchoidal markings when they fall off. The slash is hard; the outer bark is dull red-brown and the inner bark light brown and granular. The sapwood is white and the heart dark brown. The wood is fairly heavy, about 45 lb. per cu. ft. air dry, hard and strong, with a coarse texture and an interlocked grain, and so is difficult to work. It is durable and is considered termite proof. Growth rings, vessels surrounded by parenchyma, and the numerous, fine medullary rays can be seen in transverse section. In Togoland, the boles are pitsawn into planks. Fufu mortars are hewn out of the wood.

BOTANY. The leaf is paripinnate and usually consists of 4-6 pairs of opposite, glabrous leaflets. These vary in shape from



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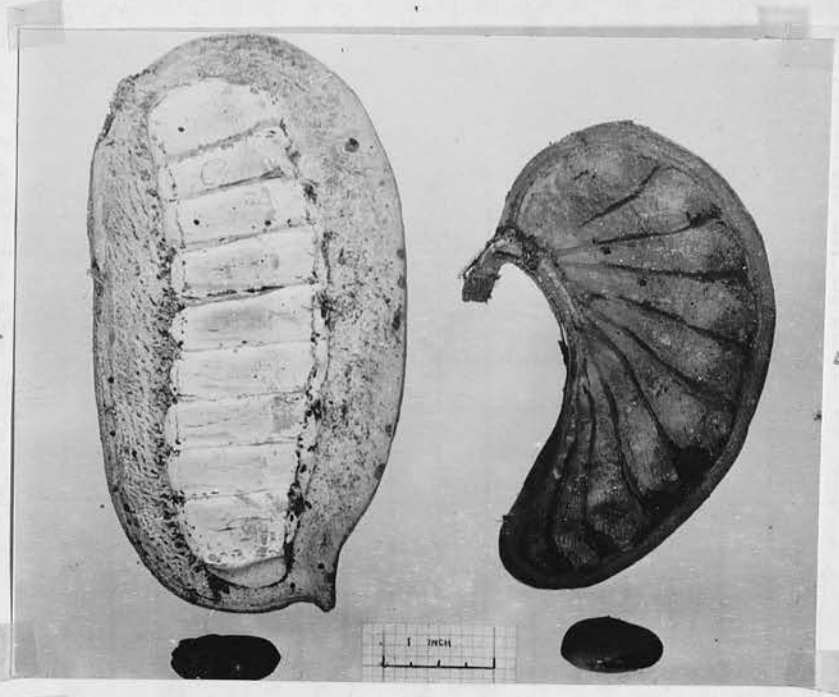

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Afzelia africana. 1. Leaf. 2. Opened pod & seed. 3. Bole. A. bella. 4. Opened pod and seed. 5. Bole.

the lowest pair which are ovate to oblong-elliptic for the upper ones. The leaflet is from 4-7 in. long and 2½-3 in. broad, and is light green, thin, acuminate (almost rounded in the lowest pair with an apiculate tip), rounded to cuneate at the base, and with a short (¼ in.) petiolule. The yellow midrib is more prominent on the underside, and the venation is reticulate. The scented flower consists of 4 sepals, a white petal with purplish markings, 7 stamens and often 2 staminodes, and a superior ovary of 1 carpel. The very hard, black, woody pod is about 4 in. long and 2 in. broad and is beaked. There are about 10 well marked, parallel septae in the pod; in each division is a black seed, about 1 in. long, covered from the base for almost half its length by an orange-red aril.

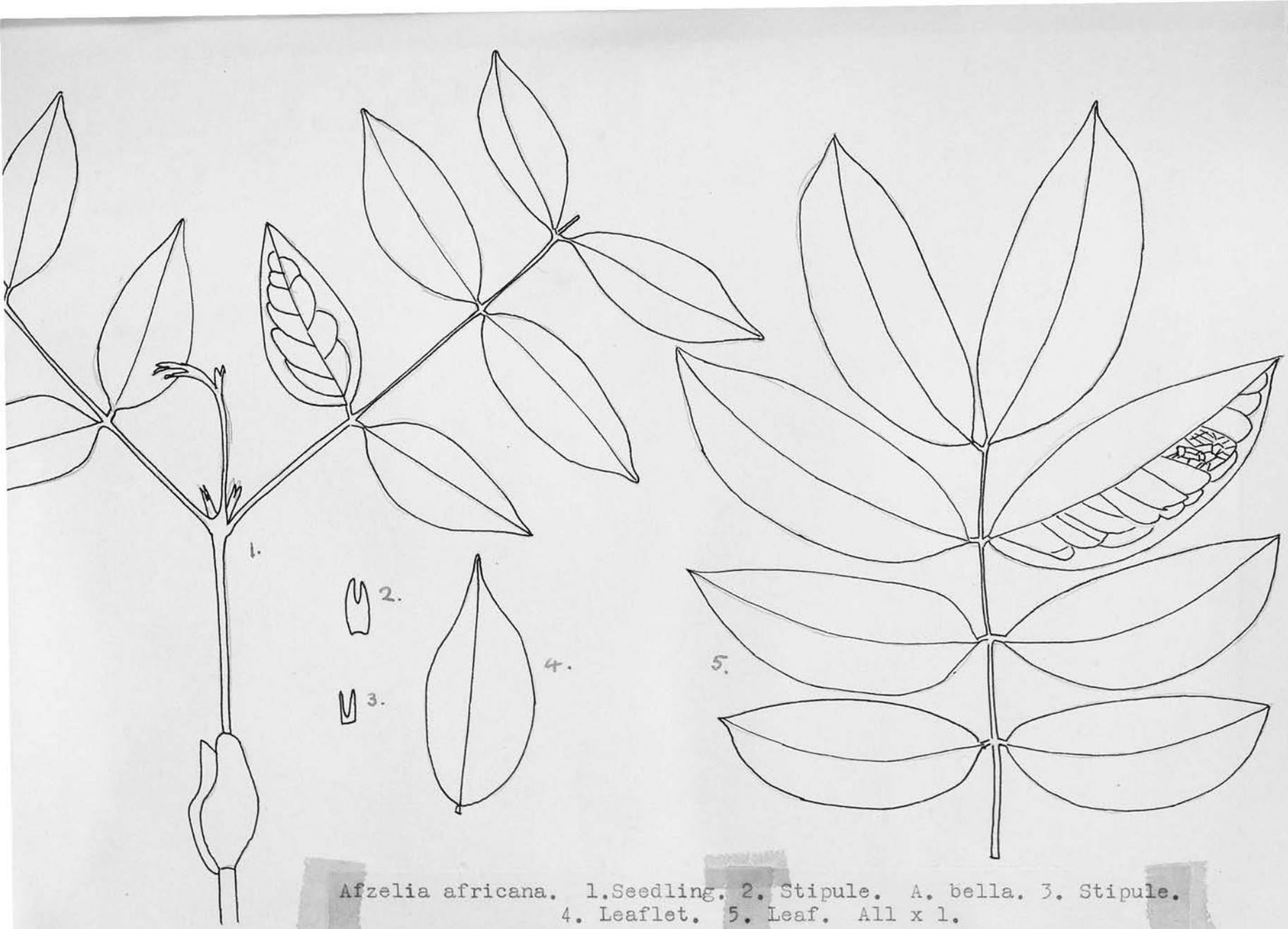
PHENOLOGY. The trees are deciduous from December to April, but not all are leafless for the whole of this period. Flushing of the new leaves may start in January. Flowers are produced in July and August, but have also been observed in January and February in the Savannah-Woodland. The dehiscent pods may persist on the trees for some months.

DISTRIBUTION & SILVICULTURE. A. africana belongs to the Savannah-Woodland and the northern edge of the High Forest Zone (Antiaris-Chlorophora Association). It is common in the Riverain Forest and in the Derived Savannah-Woodland of Togoland and Northern Ashanti. It does not usually penetrate deep into the High Forest, but is recorded from the Bia Tano and Anumsu F.Rs. This species is a light demander, but in youth it can be a partial shade bearer. It is fairly resistant to fire, and where it is found in the Savannah-Woodland, it is one of the dominant trees.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Bonkoni	170	-	1	2	-	1
Afram Headwaters	185	6	3	3	1	1
Boumfum	154	4	3	1	-	-
Northern Scarp (West)	577	24	11	2	3	2
Odomi River	43	5	2	4	-	-

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long. The green cotyledons do not expand and usually remain close up against the stem. The first two primary leaves are Paripinnate and opposite, about 3½ in. long, and are borne about 2½ in. above the cotyledons. There are 3 pairs of opposite leaflets. The glabrous leaflet is entire, oblong-elliptic, about 1½ in. long and 0.6 in. broad, acuminate, rounded at the base and with a short petiolule. The stipules are shaped like



Afzelia africana. 1.Seedling. 2. Stipule. A. bella. 3. Stipule.
4. Leaflet. 5. Leaf. All x 1.

a claw hammer and are about ½ in. long and 0.2 in. broad. The stem is glabrous. Succeeding leaves are alternate.

NATURAL REGENERATION. This is usually plentiful, although many seeds may be eaten on the ground by animals. A large quantity of seed is produced each year, and viability is high. Growth is usually slow.

ARTIFICIAL REGENERATION. Stored seed will keep up to a year. The germination period is from 12-24 days, and a plant percentage of nearly 90 can be expected at the end of 6 months. By this time the shoots may be about 9 in. high, but a long taproot, 12 in. or more in length, has developed. When lifting the plants from the nursery beds, it is better to undercut this root rather than try and dig it out. 2 year old plants, stumped, transplant well.

(ii) Afzelia bella Harms

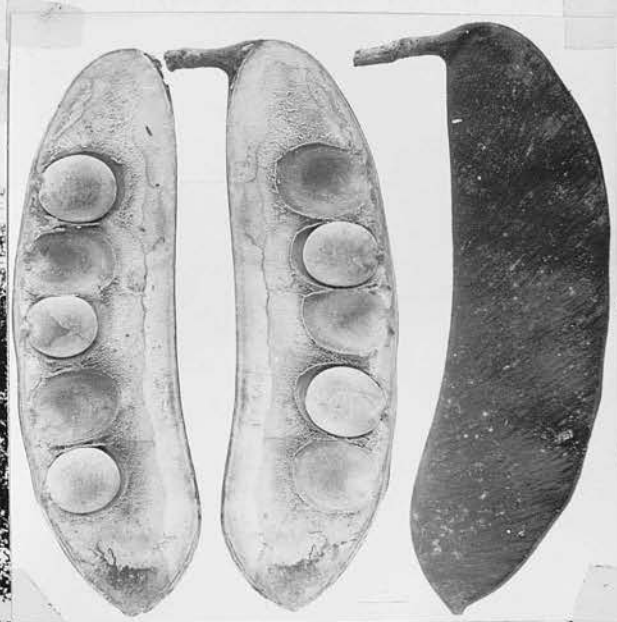
SYNONYM. A. microcarpa A.Chev.
VERNACULAR NAME. Papao (Ash,T,W).

A medium to large tree found in the closed forest. The bole is neither cylindrical nor straight. There are short buttresses at the base. The crown is thin and somewhat flattened. The bark is light coloured and has large irregular scales which leave conchoidal markings that are less concentric than those on Guarea. The slash is thick, dull yellow-brown, granular, hard and with a soya bean smell. The white sapwood shows ripple marks. The heartwood is reddish, heavy, hard and durable. In transverse section, growth rings are barely visible, but many vessels, surrounded by parenchyma, can be seen.

BOTANY. The pinnate leaves usually comprise 3-6 pairs of opposite, glabrous leaflets. The leaflet is oblong to oblong-lanceolate, 2-5 in. long and 1-2 in. broad, with a short acumen, more or less rounded base and with a short petiolule. The midrib is raised below and the nerves are very fine. The flower is borne on a stout pedicel about ¾ in. long and consists of 4 sepals. 1 petal which is white with red blotches, claw shaped and about 1¾ in. long (bigger than A. africana), 9 stamens (about 2½ in. long) of which 2 are usually shorter and infertile, and a superior red ovary of 1 carpel. The fruit is a black woody pod about 4 in. long and 1½ in. broad, and beaked. It is not as thick as that of A. africana and the septa differ from this species as they radiate so that the widest part of the division is on the outer side. The black seed, about 1 in. long and ½ in. wide, is almost completely covered by a bilobed, thin, bright red aril.

PHENOLOGY. The tree is deciduous from February to April. Flowering takes place in November and December and the pods develop quickly during January to March. Dehiscence takes place on the tree and the old opend pods may persist on the crown for

1.



3.

4.

2.

5.

Berlinia auriculata.
1. Tree. 2. Bole.
3. Pods. 4. Leaf x 1.
5. Seedling.

and slightly scented. The petals consist of a large standard and 4 rudimentary ones. There are 5 sepals, enclosed by 2 bracteoles, 10 long stamens and an ovary of one superior carpel.

PHENOLOGY. The tree is evergreen. Flowers are produced from January to May, and fruits from July to September.

DISTRIBUTION. A specimen was collected in the Rain Forest at Mpatabaa, south of the Ankasa F.R.

(ii) Berlinia auriculata Benth.

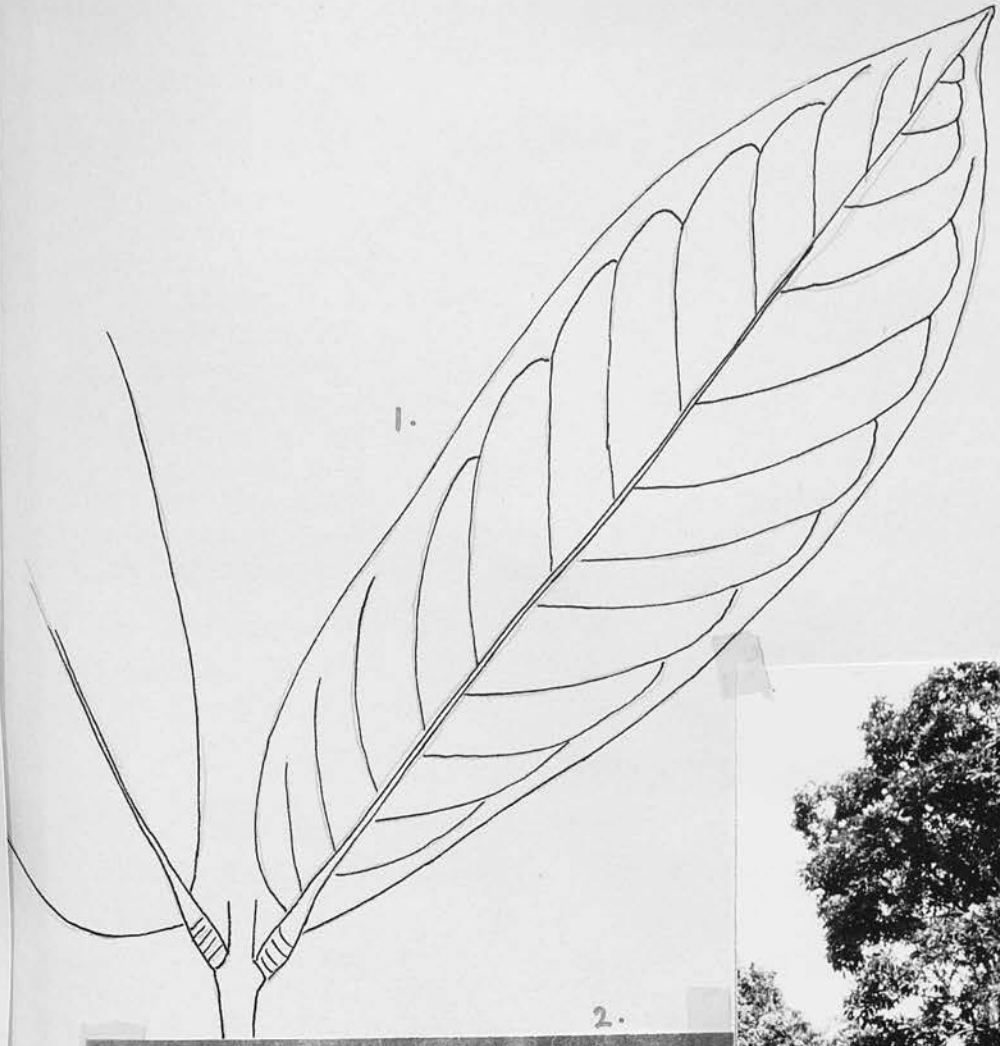
SYNONYM. Westia auriculata Macbride

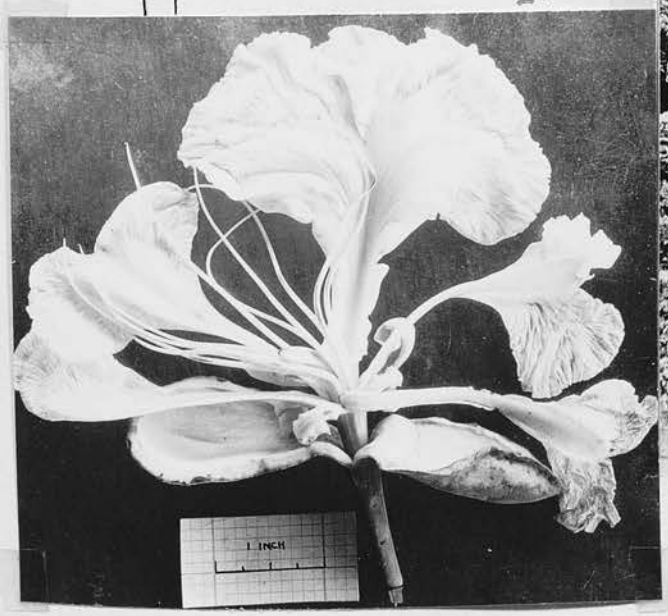
VERNACULAR NAMES. Agyemera (Nz). Kotoprepre (T).

A small to medium sized tree of up to about 60 ft. in height and seldom greater than 6 ft. G.B.H. The bole is not very straight and it has very short buttresses. The crown is dark, spreading and untidy looking, but not deep. The grey bark is fairly smooth. The slash is light brown, but darkens on exposure. The white sapwood has a sheen, and in it the large vessels show up distinctly. After a while, there is an exudation from the wound which has an unpleasant smell and a consistency something between gum and mucillage. The heart is pinkish brown, hard and heavy, and contains dark brown irregular streaks. In transverse section the vessels are visible, and also the squatly elliptic parenchyma which surrounds them. The medullary rays are very fine and can be seen with a hand lens.

BOTANY. The leaves are paripinnate and consist of 3-5 pairs of opposite leaflets, which are sloghtly asymmetric, being curved towards the inner side. The leaflet is oblong-lanceolate, about 3 in. long and 1 in. broad, entire, acuminate with a square cut tip, and with a base which is broadly cuneate to more or less rounded. The midrib and nerves are slightly raised below and are downy. The venation is reticulate. The woody petiolule is about 0.2 in. long. In the flower there are 5 green seppals, 5 white petals of which the standard is the biggest; it has a large bilobed blsde and distinctly auriculate at the base. The 10 stamens are about 2 in. long and the superior ovary contains one carpel. The woody pod is about 12 in. long and $3\frac{1}{2}$ in. broad, dark brown, beaked at the apex, with a prominent ridge along the dorsal suture, and with many shallow diagonal ridges on the outside. There are up to 6 brown, flattened, circular (about $1\frac{1}{2}$ in. diameter) seeds, attached alternately to the two sides of the pod.

PHENOLOGY. The tree is evergreen. Flowers are produced from March to May, and the conspicuous pods, which stand out at right angles to the stalks on the crown of the tree, are ripe from late September to December. Normally they open on the tree, scattering the seeds and then curl up and drop to the ground not long afterwards. In a particularly wet period, the pods may fall unopened.





Berlinia bracteosa. 1. Leaflet x 1.
2. Flower. 3. Tree.

DISTRIBUTION. This species is found scattered throughout the High Forest Zone, but has not been recorded in the Antiaris-Chlorophora Association. It is often to be found in damp places, but seldom in swamps. It may also occur on hillsides but is less common in such situations.

SEEDLING. Germination is hypogeal. The shoot is green and lightly covered with a red pubescence. The leaves are alternate, paripinnate (the first one may have but two leaflets) with usually two pairs of opposite leaflets. The first leaf is about 5 in. above ground. Above this the young shoot has a slightly zigzag appearance from node to node. The rhachis is about 3 in. long, slender and slightly rusty pubescent. The leaflet is oblong-elliptic, about 3½ in. long and 1.4 in. broad, entire, long acuminate, broadly cuneate, light green and thin, glabrous except for the short (0.15 in.) swollen petiolule which is slightly rusty pubescent. The leaflet may be a little asymmetric by curving towards the inner side.

ARTIFICIAL REGENERATION. The germination period is about 14 days.

FIELD NOTES. Easily distinguished by the auriculate standard and the square cut leaflet tips.

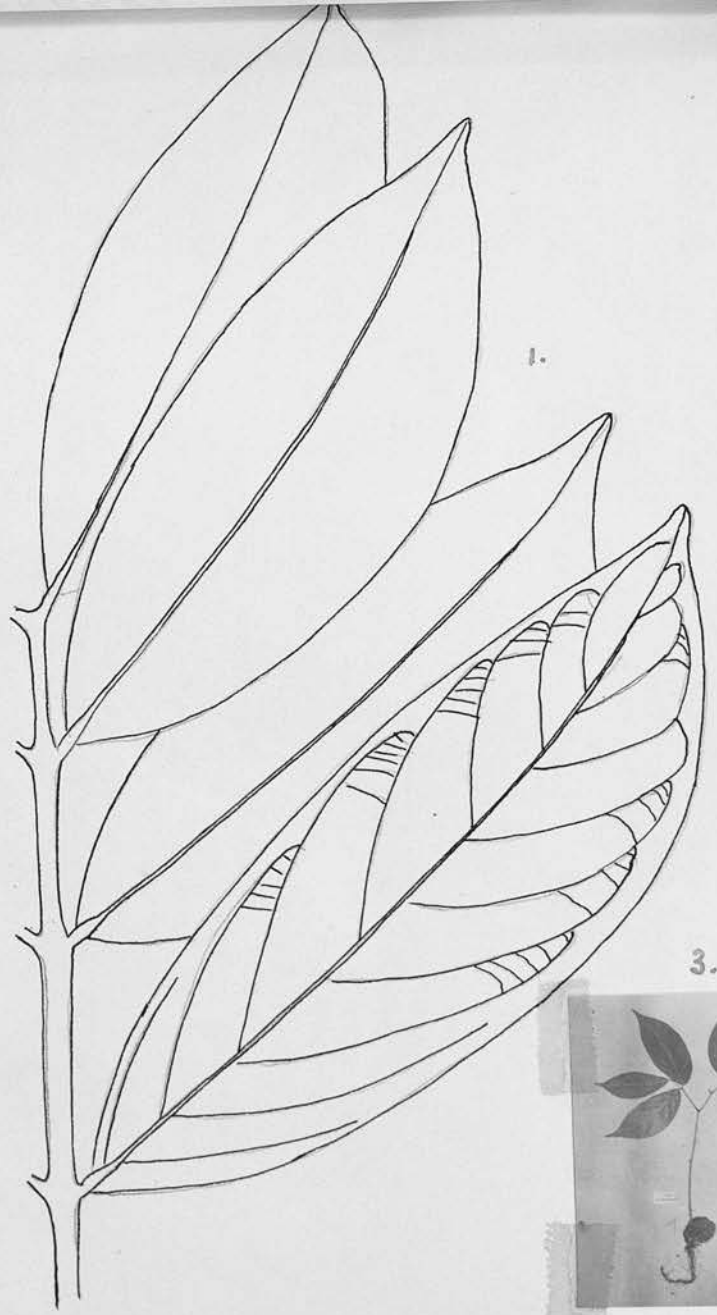
(iii) Berlinia bracteosa Benth.

SYNONYM. Westia bracteosa Macbride

VERNACULAR NAME. Fola-abrehe (nz)

A small tree, about 60 ft. high and 8 ft. G.B.H. The bole is usually twisted and knobbly. The crown is heavy, deep and close to the bole. There are thin, irregular scales on the greyish bark. The slash is light brown and thin and the white sapwood is hard.

BOTANY. The leaves are paripinnate and consist of usually 4-6 pairs of opposite to subopposite leaflets. The leaflet is oblong-lanceolate, about 7 in. long and 2 in. broad or larger , entire, bluntly acuminate and unequal at the base. The petiole is about 0.4 in. long, thick, swollen and lined transversely. The midrib and nerves are raised below. The rhachis, underside of the leaflet and the petiolule are covered with a fine rusty down when young. The flowers are borne in conspicuous terminal racemes. Two large fleshy green bracteoles, 2 in. long and 1 in. broad, subtend the white flower. There are 5 more or less petaloid sepals. This species is unique amongs t Gold Coast Berlinias in that there are 5 large petals. The standard is the biggest, being about 3½ in. long and broad. The stamens are 10 and the superior ovary consists of a single carpel. The dark brown woody pod is about 11 in. long and 4 in. broad, smooth slightly beaked at the apex and contains about 4 seed which are almost square in shape and about 1½ in. long and broad.



Berlinia grandiflora. 1. Leaflets x 2/3.
B. heudelotiana. 2. Leaf & pod.
3. Seedling.

PHENOLOGY. Flowering occurs from March to May and pods are ripe in October to December.

DISTRIBUTION. This species belongs to the Rain Forest where it is found in swamps.

(iv) Berlinia grandiflora Hutch.& Dalz.

SYNONYM. Westia grandiflora Vahl.

VERNACULAR NAMES. Agyemera (Nz,W). Tetekon (W).

A small to medium sized tree, about 70 ft. high and 5 ft. G.B.H. It is vdry similar to B. acuminata, and the only significant difference seems to be the larger flowers in B. grandiflora. It is found beside rivers and in moist depressions in the High Forest. It has been recorded from Dunkwa south-westwards to the edge of the sea.

(v) Berlinia heudelotiana Baill.

SYNONYMS. B. acuminata var. heudelotiana Oliv.
B. auriculata A.Chev.

VERNACULAR NAMES. Kotoprepre (W). Tetekon (Nz,W).

Found either as a tree or in a bushy form. One specimen had a height of 57 ft. (bole 42 ft., crown 15 ft.), and was almost 7 ft. G.B.H. In the forest the tree may have a height of 70 ft. The stem is not usually straight and is not buttressed. The crown is spreading, low and untidy. In the bushy form the habit is somewhat pendulous. The bark is smooth and mustard grey. The slash is thin and saffron, and the white sapwood has a sheen. The large vessels are conspicuous. The heartwood is reddish-brown, hard and heavy.

BOTANY. The paripinnate leaves consist of 3-5 pairs of opposite or subopposite leaflets. The leaflet is elliptic-obovate, up to about 6 in. long and 2 in. broad, entire, acuminate and broadly cuneate to rounded at the base. The midrib and nerves are slightly raised below and the venation is reticulate. The dark brown petiolule is slightly thickened and wrinkled. The leaves are glabrous, except for the rhachis, the underside of the midribs and the petiolules which are downy at first. The inflorescence is paniculate. The flower is white and sweet smelling and is subtended by 2 bracteoles. There are 5 sepals and 5 petals - the standard being large ($1\frac{1}{2}$ in. long and broad) and bilobed and the others small - 10 stamens and a superior ovary of 1 carpel. The flat woody pod is brown and tomentellous, about 12 in. long and $3\frac{1}{2}$ in. broad, rounded at both ends,and contains up to about 6 dull brown seeds, about $1\frac{3}{4}$ in. long and $1\frac{1}{4}$ in. broad.

PHENOLOGY. The tree is evergreen. Flowering takes place between February and May, and the fruits ripen from August to October. The pods are conspicuous as they are borne at right angles to their stalks and protrude from the crown. They open on the tree, scattering their seeds, and curl up and eventually fall off.

DISTRIBUTION. This species is found in the High Forest and Savannah-Woodland. It is usually associated with river banks and is a constituent of Riverain Forest and Riverain Woodland of the Guinea Savannah-Woodland.

SEEDLING. Germination is hypogeal. The shoot is fairly stout, dark green and rusty pubescent. The leaves are alternate, paripinnate, usually with 2 pairs of opposite leaflets, and the first one is about 6 in. above the ground. Above it, the young shoot has a zigzag appearance from node to node. The rhachis is about 2 in. long, swollen at the base and rusty pubescent. The leaflet is oblong-elliptic, about $4\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad, slightly asymmetric, being curved towards the inner side, entire, acuminate, broadly cuneate to almost rounded at the base, glabrous except for a few hairs on the underside of the midrib and the rusty pubescent, short (0.15 in.), stout petiolule. The venation is reticulate.

3. BUSSEA Harms

Bussea occidentalis Hutch. ex Chipp

VERNACULAR NAMES. Baman (Ash). Breniatawakoko (Ash). Kotoprepre (W). Samanta (Ash,T,W). The name Kotoprepre is also applied to Berlinia, Calpocalyx and Xylia, and Samanta to the latter.

A medium sized tree reaching up to about 80 ft., and about 7 ft. G.B.H., but more often about 50 ft. high. The bole is clear, not straight and has no buttresses. The crown is dense, dark, rounded and spreading. The bark is smooth and dark, but becomes slightly scaly in old trees. The slash is hard, granular and pinkish-brown, and ripple marks are visible in the white sapwood. The heart is dark brown and heavy, about 65 lb. per cu. ft. at 11% moisture content. It is durable against termites and borers, very strong and hard, but difficult to work with hand tools. In transverse section, the numerous vessels are barely visible; they are surrounded by parenchyma which tends to form short, irregular bands. The fine medullary rays can be seen with a hand lens. In longitudinal section the vessels are distorted and the light coloured parenchyma shows up distinctly.

BOTANY. The leaves are bipinnate; there are usually 2-3 pairs of opposite pinnae. Normally there are from 4-6 alternate leaflets on each pinna. The leaflet is ovate-elliptic to oblong-elliptic, about $3\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. broad, curved slightly, entire, glossy dark green above and pale dull green below, with a large acumen and more or less rounded base. The midrib is raised

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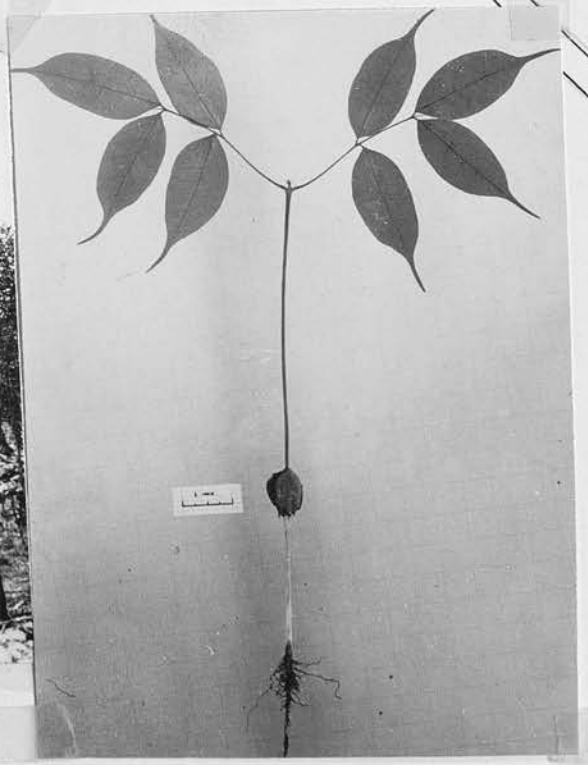

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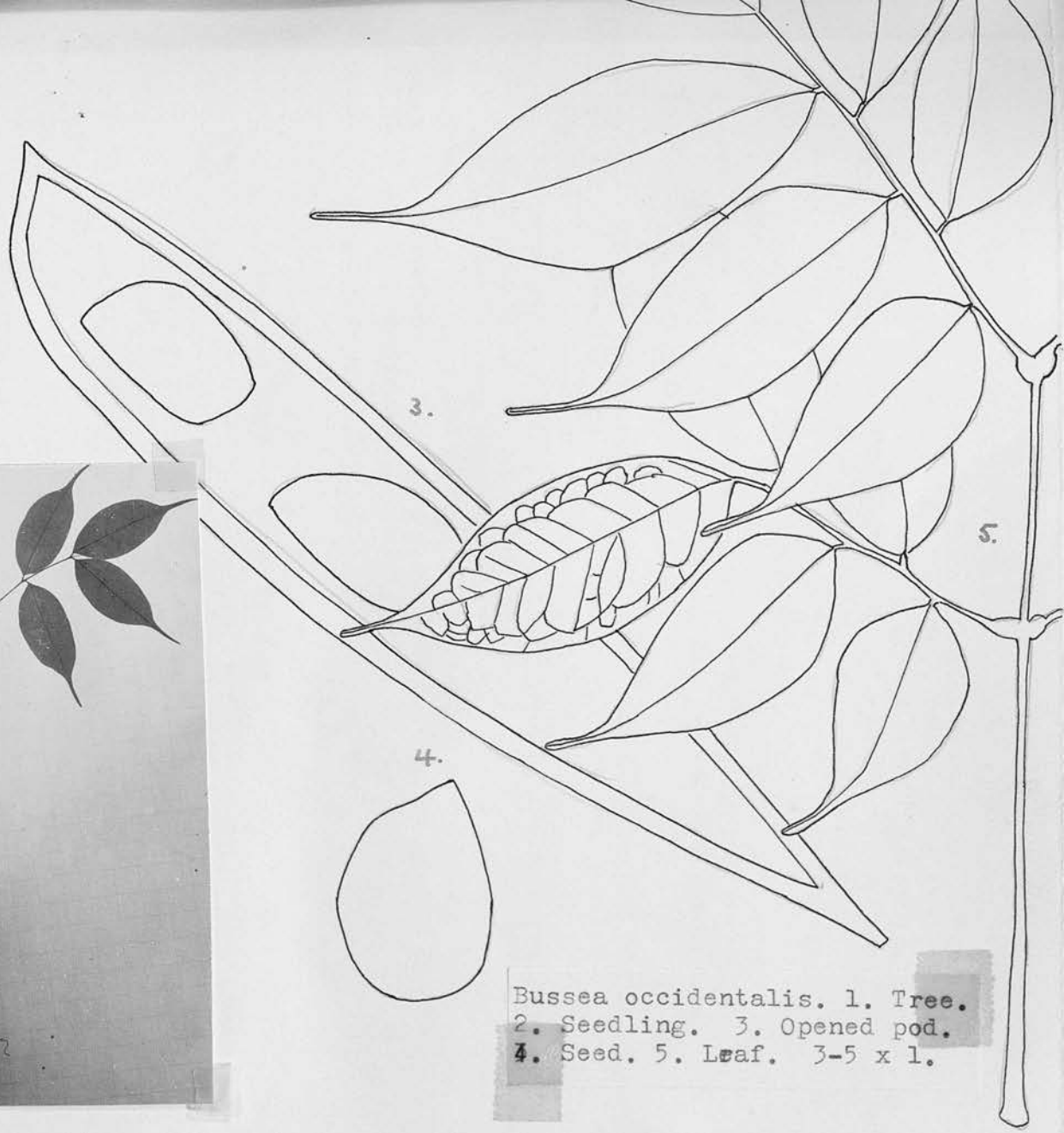

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5.

Bussea occidentalis. 1. Tree. 2. Seedling. 3. Opened pod. 4. Seed. 5. Leaf. 3-5 x 1.

below and the nerves are fine. The petiolules are short. The rhachis, secondary rhachis, petiolules and undersides of the midribs are covered with a golden red pubescence when young. On the underside of the lamina are a few scattered hairs of the same colour but shorter. The caducous stipules are linear and about ¾-1 in. long. The flowers are in racemes. There are 5 sepals, 5 petals about 1 in. long, yellow with brown markings and rather crumpled, 10 yellow stamens and a superior ovary of 1 carpel. The fruit is a hard, woody pod, narrowly oblanceolate, about 7 in. long, 1½ in. broad and ½ in. thick, dark brown and velvety. There are usually two pale brown seeds, flattened, and 1½ in. long and 1 in. broad.

PHENOLOGY. Bussea is evergreen. It has a long flowering period from about mid June to the end of November. The yellow flowers are abundant and cover the whole crown of the tree. They present one of the more colourful sights in the forest. The conspicuous pods which protrude above the crown begin to form in September. Seeds are available from November to March. The pods split vigorously on the tree into halves, scattering the seeds. Not long after dehiscence, the opened pods may be found on the ground. They tend to become recurved.

DISTRIBUTION & SILVICULTURE. Bussea is widespread as a lower storey tree in the High Forest Zone. It is common - but less so in the Rain Forest. It is a shade bearer and prefers soils where the drainage is good. It grows slowly and steadily. Its dense crown, which is liable to become spreading, is often a hindrance to the development of young trees under it. This is very evident in areas where canopy openings have been made for encouraging natural regeneration.

Enumeration surveys give the following frequencies:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Cape Three Points	129	7	4	-	-	-
Kakum	150	71	5	-	-	-
Bonsa River	27	29	8	1	-	-
Bobiri	94	25	12	4	-	-
Afram Headwaters	185	55	36	1	-	-

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long. The cotyledons do not develop. They are oblong, about 1 in. long and ¾ in. broad, rounded at the apex and auriculate at the base, sessile, thick and glaucous. The first two primary leaves are produced about 4½ in. above the cotyledons and are opposite and paripinnate. They have two or more pairs of leaflets. The leaflet is elliptic, up to 4 in. long and 3 in. broad, entire, with a long acuminate tip, a more or less rounded

base and a short petiolule. The lamina is dark glossy green above and dull green below. The stipules are acicular. The shoot, rhachis and undersides of the leaflets are covered with golden brown silky hairs. Succeeding leaves are alternate. The 3rd. leaf is bipinnate, with usually 4 alternate leaflets on each pinna. They are rusty tomentose.

NATURAL REGENERATION. This is plentiful and the strong seedlings are conspicuous in the forest where the canopy is not too open. Although the tree is a shade bearer the sedling will not develop where the shade is intense. Early growth is vigorous, both in the seedling and sapling stages. The sapling may have an annual height increment of from 7 in. to 16 in.

AARTIFICIAL REGENERATION. Germination begins in 5 days and is about 90%.

PATHOLOGY. The seedling is occasionally attacked by a shoot borer, but soon recovers.

4. CYNOMETRA L.

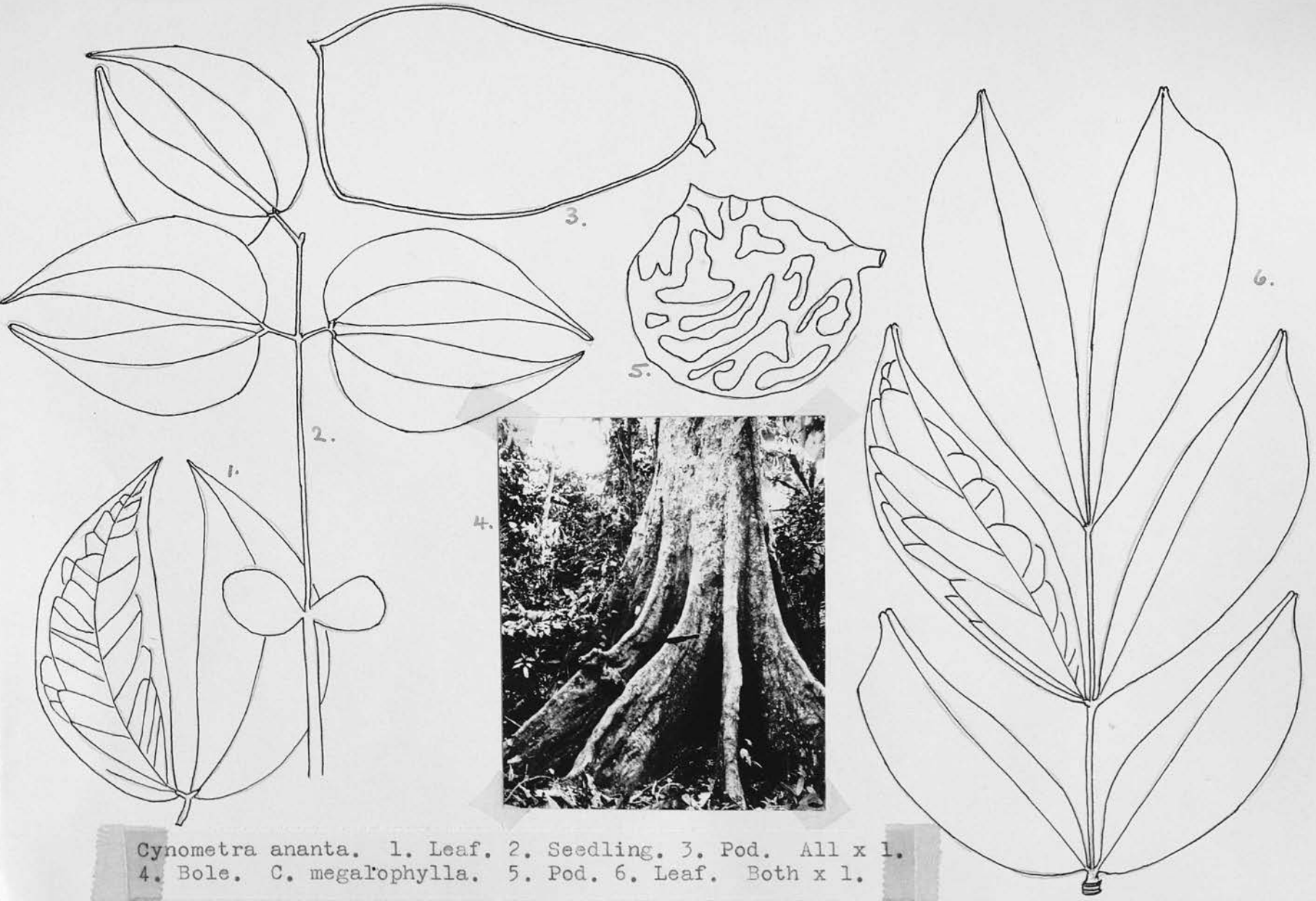
Besides the two species described below, there is C. vogelii Hk.f., a riparian tree of the Savannah-Woodland.

SPECIES. (i) C. ananta Hutch.& Dalz. (ii) C. megalophylla Harms

(i) Cynometra ananta Hutch.& Dalz.

A tall tree, 100 ft. or more in height and about 11 ft. girth above buttresses. The numerous narrow buttresses sometimes extend 15 ft. up the bole. The latter is often twisted, knotty and gnarled, and seldom exceeds a length of 50 ft. Often it is less. The crown is rounded and tends to be spreading and is composed of big branches. The general appearance of the tree is rather untidy. The light grey bark is irregularly scaly and mustard coloured marks are left when the scales are sloughed off. The slash is hard, dull reddish-brown, and darkens quickly on exposure. Fine ripple marks are visible in the white sapwood. The reddish-brown heart is dense, hard, strong, very durable and heavy (57 lb. per cu. ft. at 12% moisture content). In transverse section the vessels are barely visible. The parenchyma forms fairly regular fine transverse continuous bands. With a hand lens. many very narrow medullary rays may be seen. The tree has has no present economic use in the Gold Coast.

BOTANY. The leaf consists of 2 opposite leaflets borne on a short, slender petiole, about 0.2 in. long. The leaflet is broadly sickle-shaped, about 3 in. long and 1 in. broad, entire, glabrous, acuminate, unequal sided at the base. The midrib is a little nearer to the inner margin and is slightly raised below.



Cynometra ananta. 1. Leaf. 2. Seedling. 3. Pod. All x 1.
4. Bole. C. megalophylla. 5. Pod. 6. Leaf. Both x 1.

The nerves are fine. There is a very short, slender petiolule. The inflorescence is a short cyme. The flower consists of 5 sepals, 5 white petals, 10 stamens and a superior ovary of 1 carpel. The fruit is a 1-seeded, beaked, thin, woody pod, about 3½ in. long and 1½ in. broad, on a short, stout stalk. The seed is brown, flat, about 1 in. long and ¾ in. broad and is situated in the centre of the pod.

PHENOLOGY. The tree is evergreen. Flushes of new leaves take place in March-May and August-September, and during these periods and later, the crown of the tree is a mass of bright red. In such a condition, the trees present a lovely sight, especially if they can be viewed from a vantage point. The flowers occur in October-November. The pods mature quickly and ripe seeds are obtainable from December to February.

DISTRIBUTION & SILVICULTURE. C. ananta is found throughout the Rain Forest. It extends into the Moist Semi-Deciduous Forest in the south-west, and groups of it are to be found near Dunkwa, and along the Dunkwa-Diaso road. It is sometimes semi-gregarious, and although it grows in moist situations, but not swamps, it is just as common on the hills. These hillside trees present a pretty picture to the railway traveller on the Takoradi-Tarkwa line when they are covered in their vivid red flush. In the seedling stage it is a shade bearer.

Enumeration surveys give the following frequencies:

Girth classes in feet.

Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Ankasa River	120	28	12	6	4	-
Cape Three Points	129	130	88	40	8	2
Ndumfri	175	22	54	41	29	-
Subri	965	145	107	119	29	14
Yoyo	569	500	463	121	60	89

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long and is light brown, glabrous, woody and stout. The cotyledons do not develop and are about ½ in. long, rounded and somewhat shrivelled. The shoot is slender, and the first two primary leaves are produced onit about 2 in. above the cotyledons. These leaves are opposite; succeeding leaves are alternate. The leaves are similar to the adult ones except that the leaflets are inclined to have a longer acumen. There are no stipules.

NATURAL REGENERATION. This is abundant and is particularly common under the mother trees, if the undergrowth is not too dense. The seedling appears to prefer moderate shade.

FIELD NOTES. This tree may be confused with Guibourtia ehie mainly because of the similarity of the leaves. Spot differences are as follows:

Character	C. ananta	G. ehie
Midrib	Almost central	Near the inner margin.
Stipules	Absent	Foliaceous
Pod	Beaked	Rounded
Cotyledons	Not developing	Foliaceous
1st.two primary leaves	Opposite	Alternate

The pod may be confused with that of Daniella, but there the single seed is near the apex of the pod, whereas it is central in C. ananta.

(ii) Cynometra megalophylla Harms

VERNACULAR NAMES. Ahwirewa (Ash). Anam (W). Towoti (E).

A tree, usually 30-40 ft. high, and about 6 ft. girth, but it may attain a height of 70 ft. The bole is short because the habit of the tree is to branch low. Epicormic shoots are common. The crown is heavy, droopong and hearly reaches the ground. The branches are big. The bark is light grey and fairly smooth. The slash is thick, hard, finely granular and light pinky-brown. The white sapwood has a slight sheen. The heart is reddish-brown, hard and heavy.

BOTANY. The dark green, shiny, glabrous, coriaceous leaves are composed of usually 3 pairs of opposite leaflets, of which the uppermost ate the longest. The lowest pair is borne at the base of the rhachis and the petiole is very short and stout. The rhachis is channelled above. The leaflet is obliquely lanceolate to obliquely elongate-oblong, about $3\frac{1}{2}$ in. long and 1 in. broad, or larger, entire, abruptly acuminate and emarginate, unequal at the base and sessile. The midrib is conspicuously nearer the inner margin, and it and the fine nerves are raised above and below. The venation is reticulate. The flowers are white and the pod is about 2 in. long, $1\frac{1}{2}$ in. broad, $\frac{1}{2}$-$\frac{3}{4}$ in. thick. light brown, beaked, warted, indehiscent and 1-seeded.

PHENOLOGY. The tree is evergreen. The new leaves are produced in pendulous bunches and are light coloured. Profuse white flowers are to be seen in November and December, and the pods ripen between March and May. They fall to the ground unopened.

DISTRIBUTION & SILVICULTURE. C. megalophylla is essentially a riparian tree and is to be found along the banks of the Afram, Volta and Pra. It also occurs in wet depressions in the flood plains of the rivers and is common in the low lying ground to the north of Cape Coast - Saltpond where flooding is liable during the rainy season. It has not been observed in swamps.

SEEDLING. Germination is hypogeal and the cotyledons do not emerge from the pod. The first two primary leaves are opposite, compound and similar to the adult leaves. They are borne about 5 in. above the ground. The succeeding leaves are alternate. The stem is pubescent and the stipules are lanceolate.

NATURAL REGENERATION. This is usually fairly abundant near the mother tree. Seedling under the dense crown of the latter have little hope of survival.

ARTIFICIAL REGENERATION. There is one record of an attempt at this, given in a 1910 German Report on Togo - "Blanks in a wet situation were filled with Cynometra megalophylla seed at stake which came on well. This species should be noted as a possibility for stocking swampy ground". The result is not known.

5. DANIELLIA Benn.

In the Gold Coast this genus consists of three species. D. oliveri Hutch.& Dalz. is a tree of the Savannah-Woodland , especially in its southern parts and in the Derived Savannah-Woodland.

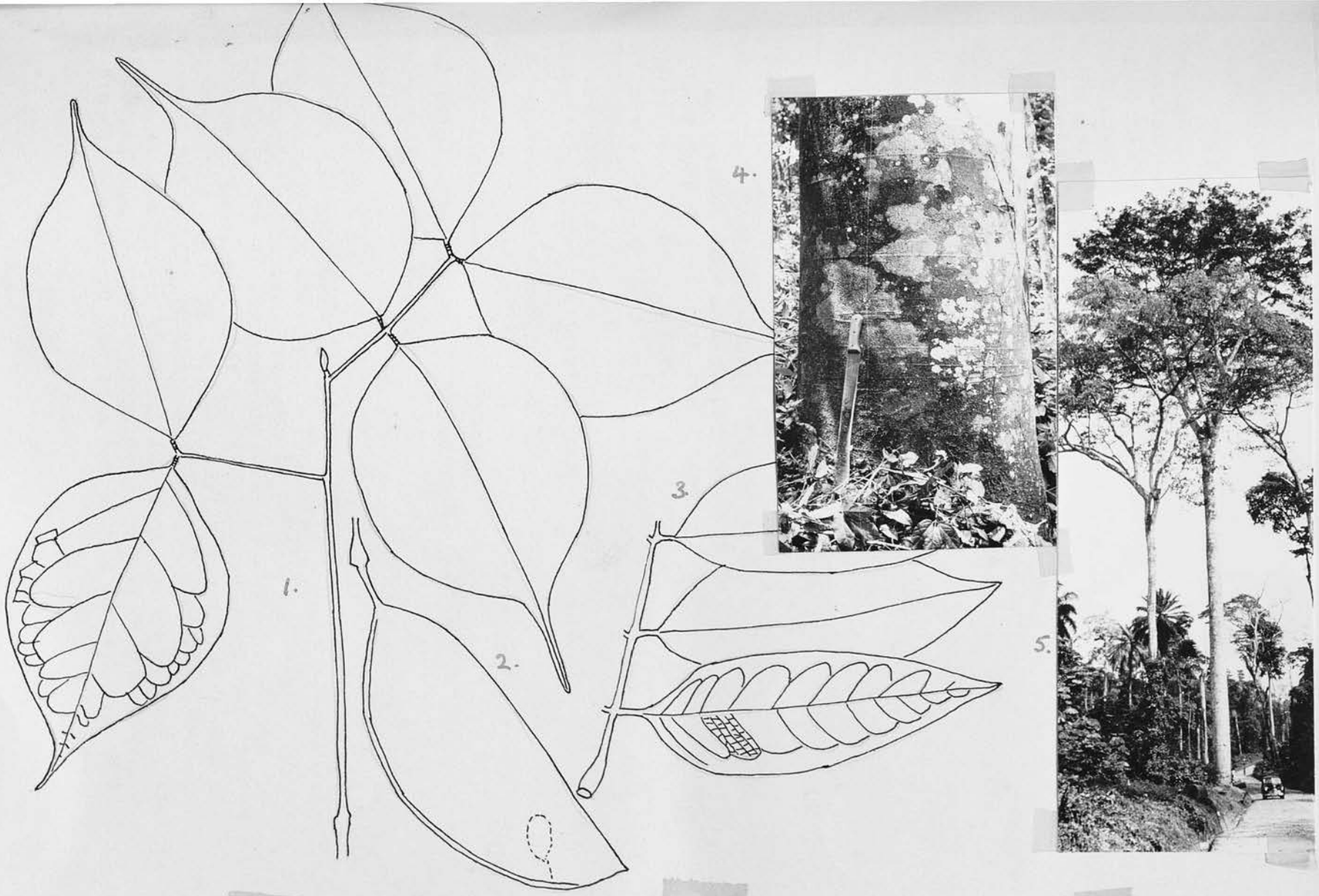
SPECIES. (i) D. similis Craib (ii) D. thurifera Benn.

(i) Daniellia similis Craib

VERNACULAR NAMES. Eyere (Nz). Hyedua (Ash, T, W).

A very tall tree, reaching a height of 140 ft. or more. The girth is often greater than 12 ft. One specimen measured in the Pra-Anum F.R. was 14 ft. 8 in. G.B.H., and another near Begoro 22 ft. 3 in. The bole is remarkably clear and straight, tall and cylindrical, and is without buttresses. On the bole are characteristic narrow, slightly raised "rings". The crown is thin, compact, rounded, but flat topped in the old trees. The bark is hard and smooth, and the slash is pink, granular and fairly thin. Ripple marks are obvious in the sapwood. The heart is soft, grey-brown and gummy. In transverse section the scattered vessels and many fine medullary rays are just visible. At the end of each growth ring is a line of parenchyma. Lumps of gum copal are often found in the ground at the base of the tree, and are due to an exudation. This seems to be brought about by insect or other damage, but attempts to produce it by tapping have not been successful. The name hyedua means gum tree.

BOTANY. The paripinnate leaves are up to about 8 in. long and consist of about 8 pairs of opposite leaflets. The petiole base is swollen and the lowest pair of leaflets is about 1 in. above it. The leaflet is oblong-lanceolate to lanceolate, about 2½ in. long and nearly 1 in. broad, entire, acuminate, more or less rounded at the base, green, shiny and glabrous. The midrib is prominent below but the nerves are fine and not very distinct. A fine, white marginal nerve may be seen when the leaflet is



Daniellia similis. 1. Seedling. 2. Pod. 3. Leaflets. All x 1.
4. Bole. 5. Tree.

held against the light. The leaflet is dotted with numerous pellucid glands. The petiolule is short and swollen. The sapling leaf is slightly different. The leaflet is oblong-lanceolate, about 3½ in. long and 1¼ in. broad, and has a more pronounced acuminate tip. There are usually fewer leaflets - about 5 pairs. The young shoot is shiny green. The stipular sheath around the bud is caducous. The flowers are scented and all the parts are mauve to violet. The swollen torus is noticeable and the petals may be unequal in size. There are 10 stamens - 9 united and one free. The ovary is pubescent and stalked. The bracteoles are caducous. The fruit is a flattened, coriaceous pod, about 2½ in. long and 1 in. broad, stalked and pointed. It contains a single seed near the apex.

PHENOLOGY. The tree is deciduous from November to early January. The new leaves flush red. Flowering usually takes place when the tree is leafless, but may begin earlier. The young fruits make their appearance in December, and ripen from February to April. Relatively few fruits are produced. They split open on the tree and the seed is blown away, attached to one half of the pod.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone except for the highest rainfall parts of the Rain Forest. It is a light demander and prefers damp situations. It does not occur in swamps, but is often found near them, even where drainage is imperfect. This species is never found in quantity, and rarely in young Secondary Forest. Natural regeneration does not succeed unless there is sufficient overhead light for its development.

Enumeration surveys give the following frequencies:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Onuem-Nyamibe Shelterbelt	62	14	1	2	-	3
Bobiri	94	3	4	2	-	2

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, brown and woody. The stem is green. The leaves are alternate and the first one is about 3 in. above the cotyledons. It is compound and usually consists of two opposite leaflets. The second leaf has two pairs of leaflets, and so on. The number of pairs of leaflets varies between seedlings and seems to be related to the conditions of overhead light. The leaflet is ovate, about 2½ in. long and 1½ in broad, entire, containing many pellucid gland dots, with a long acument, rounded to broadly cuneate at the base and with a short, dark, wrinkled petiolule.

(ii) Daniellia thurifera Benn.

SYNONYMS. Cyanothyrsus oblongus Harms D. caillei A.Chev.

VERNACULAR NAME. Sopi (Nz,W).

A tall tree similar in habit to D. similis. A specimen measured in the Subri F.R. was 172 ft. high and 16 ft. 6 in. G.B.H. The "rings" on the bole, so characteristic of D. similis, are indistinct in this species. The bark is rugose and scaly when old. The slash is dull red-brown, granular and hard. Ripple marks are conspicuous in the yellow-white sapwood.

BOTANY. The alternate leaves are paripinnate, about 6-10 in. long, and contain 5-9 pairs of opposite or subopposite leaflets. The leaflet is stiff, glossy, glabrous, oblong-lanceolate to lanceolate, about 2½ in. long and 1 in. broad, gland dotted, entire, acuminate and often unequal sided at the base and rounded. The dark, wrinkled petiolule is about 0.3 in. long. The brown midrib is raised below. The nerves are not prominent but a fine reticulated venation is visible. There is a yellow marginal nerve which is white when young. The flowers are scented and are violet-reddish. Two of the petals are usually vestigial. The ovary is glabrous and the pod is similar to that of D. similis.

PHENOLOGY. As for D. similis.

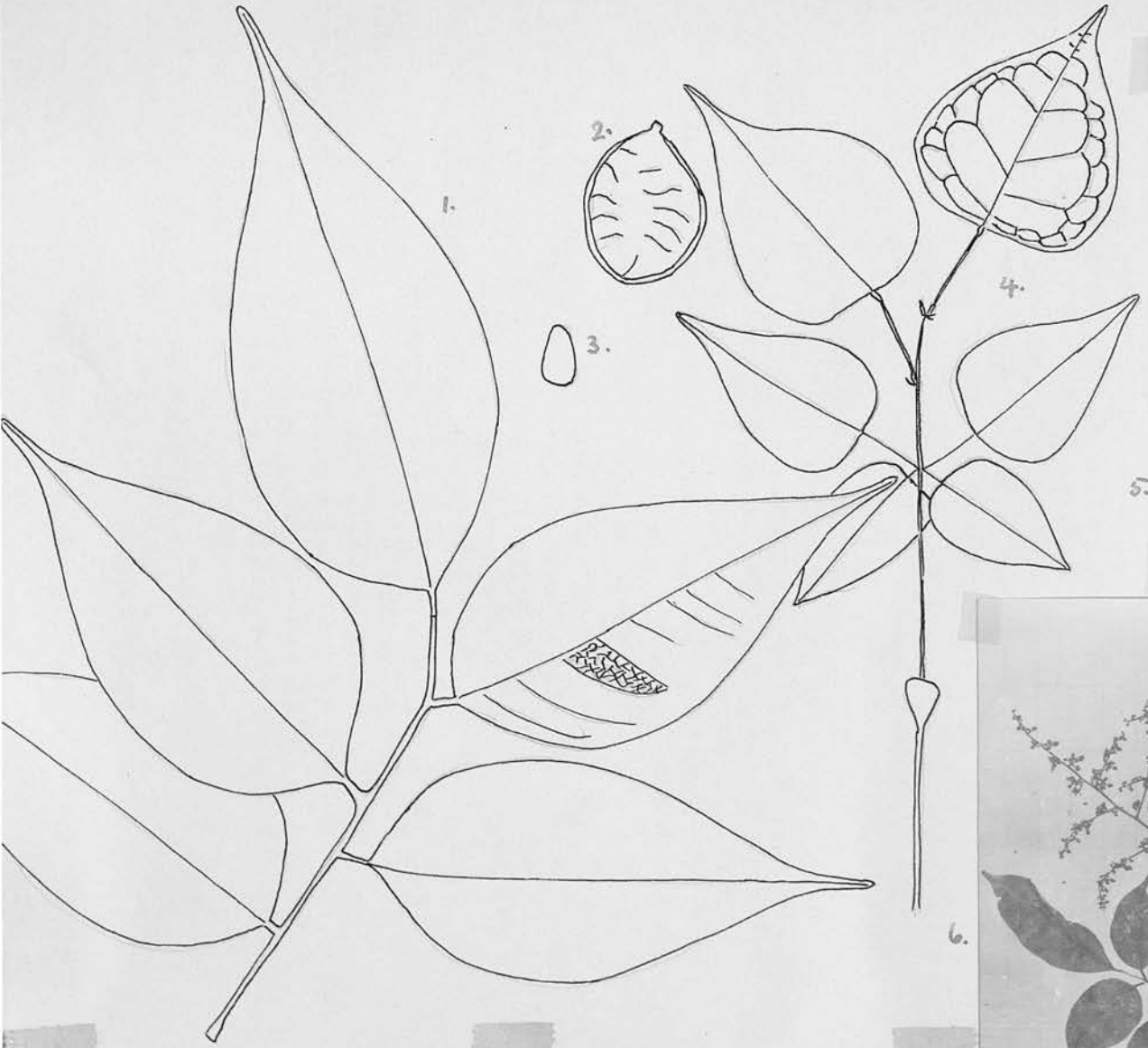
DISTRIBUTION & SILVICULTURE. Tis species occurs in the Rain Forest. It is similar in characteristics to D. similis.

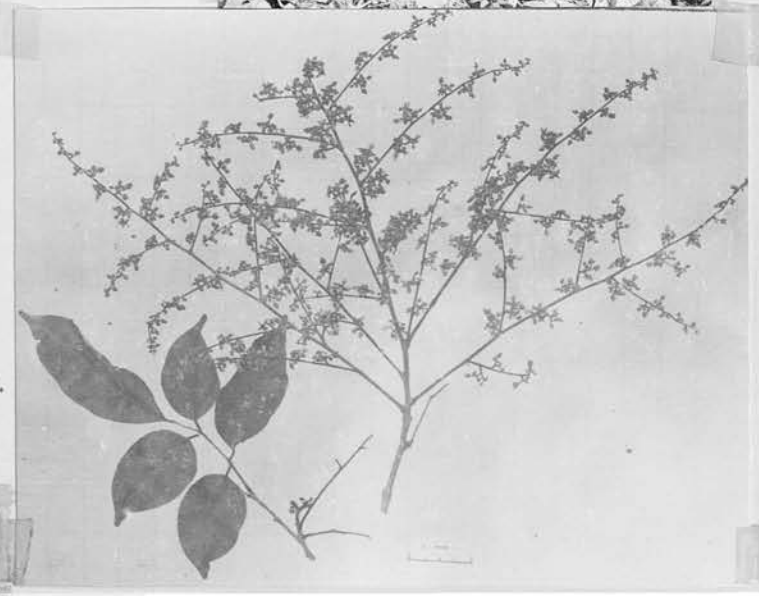
Enumeration survey figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Ankasa River	120	44	16	2	5	4
Cape Three Points	129	101	16	5	6	2

FIELD NOTES. D. similis and D. thurifera are similar in many respects. They are hardly to be distinguished by their leaves. The colour differences in the flowers are not marked because there are gradations from mauve to violet-reddish, and the colours are affected by the state of the freshness of the flowers. The rugose bark is not apparent in the younger specimens of D. thurifera.

The pod may be confused with that of Cynometra ananta - q.v.





Dialium aubrevillei. 1.Leaf. 2.Pod. 3.Seed. 4.Seedling.
All x 1. 5.Bole. 6.Leaf & flowers.

6. DIALIUM L.

This genus is represented by 3 trees in the Gold Coast. The fruits are unusual in that they are indehiscent and do not look like legumes.

SPECIES. (i) D. aubrevillei Pellegr. (ii) D. dinklagei Harms (iii) D. guineense Willd.

(i) Dialium aubrevillei Pellegr.

VERNACULAR NAMES. Duabankye (W). Mangyene (Nz)

A medium sized tree of up to about 90 ft. height and 8 ft. girth above buttresses. The latter are narrow and may extend to about 7 ft. above ground. The stem is slender and may be about 40 ft. long. The crown, although deep and much branched, is not spreading, and remains quite close to the bole. The bark is light grey. The slash is thin and deep red; copious red sticky juice flows from the wound. Abundant ripple marks are to be seen in the underbark and in the whitish sapwood. The heartwood is dark brown and hard.

BOTANY. The compound leaf consists of 4 or 5 alternate leaflets on a slender rhachis. The leaflet is ovate to ovate-elliptic, about 3 in. long and 1½ in. broad, entire, with a large acuminate tip and usually a rounded base. The short prtiolule is about ¼ in. long. The midrib is prominent below. The nerves are fine and the reticulate venation is conspicuous. Many minute pellucid glands may be seen in the lamina by means of a hand lens. The flowers are in cymose panicles. The glabrous pod is indehiscent, black, orbicular, about ½ in. diameter, containing 1 or 2 seeds. The seed is more or less pear shaped, flattened, about 0.4 in. long and 0.2 in. broad, and dull light brown.

PHENOLOGY. The profuse yellow-white flowers cover the crowns from September to November, and the fruits are available from January to March. They can be collected around the base of the mother trees. Considering the numerous flowers that are produced, the fruits cannot be described as plentiful.

DISTRIBUTION & SILVICULTURE. This tree belongs to the Rain Forest, where it is fairly common. However, it also occurs in the southern part of the Moist Semi-Deciduous Forest. Specimens have been recorded from the Pra-Anum and Esuboni F.Rs. In the Rain Forest it appears to prefer rising ground, and is conspicuous when in flower on the hills near Benso. It is less frequent in valleys abd avoids swamps.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, brown and woody. The cotyledons do not develop. The first primary leaves are borne about 1½ in. above the cotyledons and are in a whorl of 4. The succeeding leaves are alternate. The 6th. leaf is simple, cordate, about 1½ in. long

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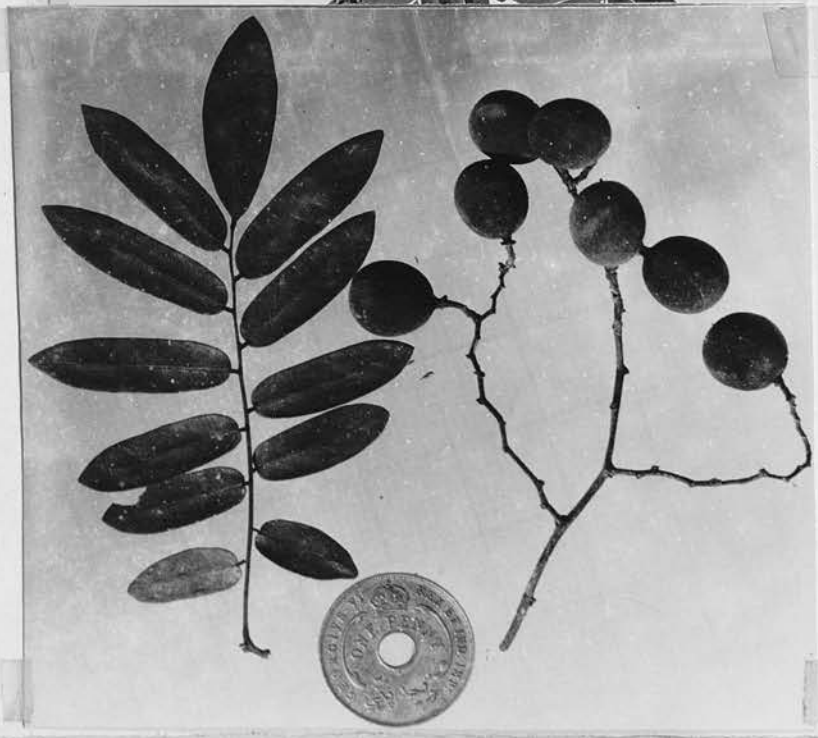

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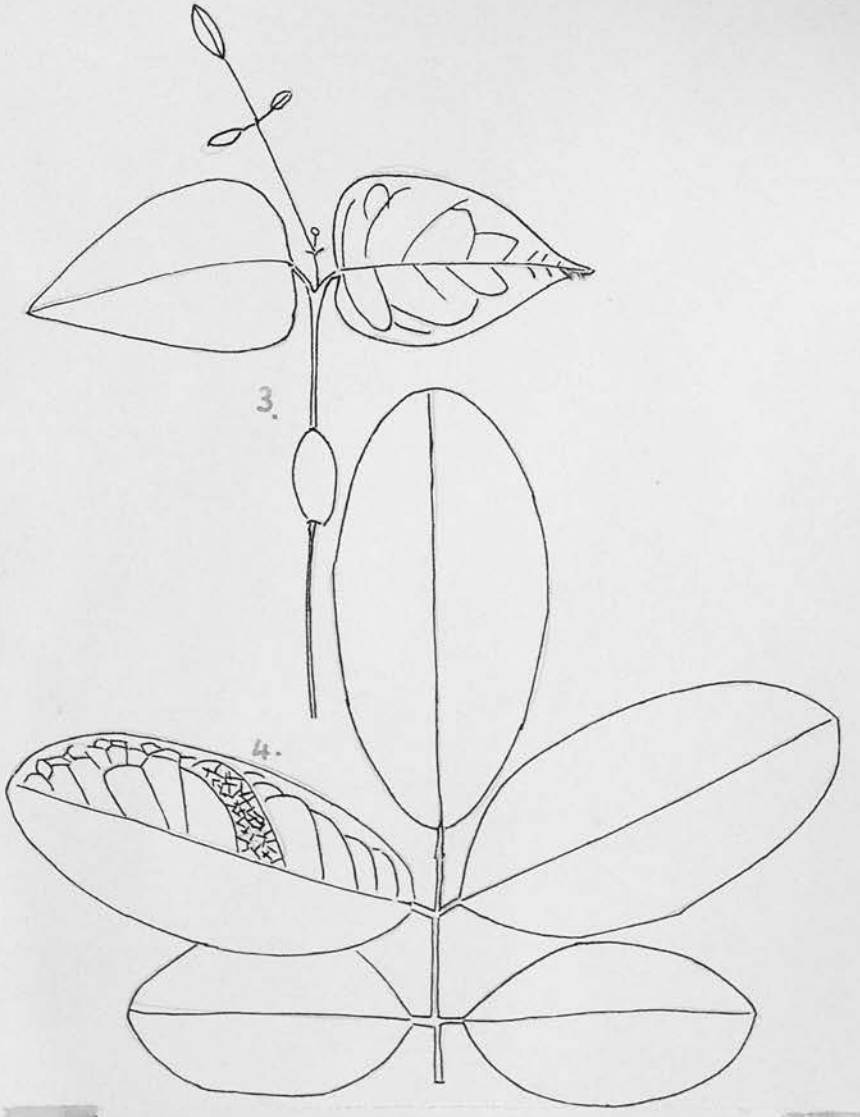


Dialium dinklagei. 1.Flowering branchlet.
2.Leaf & fruits. 3. Seedling. x 1.
D. guineense. 4. Leaf x 1.

and 1¼ in. broad, entire, acuminate, sub-cordate at the base, thin and with a reticulate venation. The petiole is ½ - ¾ in. long, slender, and swollen at both ends. The stipules are small and acicular. The shoot, petioles, midribs on the undersides and stipules are covered with a light brown pubescence.

(ii) Dialium dinklagei Harms

VERNACULAR NAME. Awendade (D,W). This means iron eater.

A small to medium sized tree of the lower storey, which does not usually exceed 80 ft. high and 5 ft. G.B.H. The bole is straight, with narrow, slender buttresses, and the crown is small. The bark is smooth, light grey. The hard, granular slash comprises a thin yellow-brown layer, under which is a speckled, liver red layer and then a brown one. A little light brown, slightly sticky gum exudes from the region of the cambium. The sapwood is white and hard. Ripple marks are prominent.

BOTANY. The alternate leaves are imparipinnate and about 6 in. long. There are about 5-8 pairs of opposite leaflets which get bigger towards the apex of the leaf, and a terminal leaflet. The leaflet is narrowly oblong, up to about 2 in. long and 0.6 in. broad, entire, dull green above and light green below, acute, with a rounded base, and a short petiolule. The midrib is depressed above and raised below. There is a red-brown pubescence on the rhachis, petiolules, and on the underside of the leaves. The flowers are in terminal panicles of cymes. The 5 sepals are light yellow. There are no petals and only 2 stamens, one of which is much reduced. The short stalked pod is globose, ½-¾ in. diameter, dark brown velvet covered, brittle and indehiscent, and usually contains i seed., which is shiny, round and flattened, about 0.25 - 0.3 in. diameter and finely striated. The pods are clustered.

PHENOLOGY. The tree is deciduous from October to mid November. Profuse flowering takes place in March-April, and the trees are very conspicuous with their yellow terminal panicles. The fruits are ripe in November and December, and fall without opening.

DISTRIBUTION & SILVICULTURE. This species is a lower canopy tree of the Moist Semi-Deciduous Forest. It has not been recorded from the Rain Forest nor from the Antiaris-Chlorophora Association. It is usually found in well drained places and avoids damp situations. Although not a shade bearer, it is tolerant of light shade.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, slender, more or less square in section, light brown and has sparse, short hairs. The cotyledons do not develop; they are elliptic, nearly ½ in. long and ¼ in. broad, and slightly auriculate at the base. The first two leaves are

are about 1¼ in. above the cotyledons, opposite, simple, ovate, nearly 1½ in. long and 1 in. broad, dull green and with a petiole 0.2 in. long. All parts of the seedling are covered with sparse short hairs. The succeeding leaves are alternate and all are stipulate. The 3rd. leaf may be simple or trifoliate.

(iii) Dialium guineense Willd.

SYNONYM. D. nitidum Guill.& Perr.

VERNACULAR NAMES. Asanaba (W). Atsitoe (E). Osenaa (F,T).

Known as the Velvet Tamarind.

A small tree rarely exceeding 40 ft. high and 4 ft. G.B.H. The bole is slender but branching is usually low. The slash is red and from it a little gum exudes. The wood is hard, heavy, light brown, with a fine texture, and is ripple marked. In transverse section very numerous, continuous, slightly wavy parenchyma bands can be seen. The wood is said to be a good firewood and to make a good charcoal. The pulp of the fruit is eaten.

BOTANY. The alternate leaves are imparipinnate and usually consist of two pairs of opposite leaflets and a terminal one. The leaflet is elliptic, about 2¼ in. long and 1¼ in. broad, entire, obtuse and with a rounded base. The midrib is raised below and the nerves are fine. On the underside the reticulated venation is prominent. The petiolule is short and slightly swollen. The rhachis, petiolules and underside of the midribs are pubescent. The white flowers are paniculate. The pod is orbicular, about 1 in. diameter, densely black-brown velvety, indehiscent and contains one seed embedded in a dry, acidic pulp.

PHENOLOGY. Flowering takes place in September to November, when the tree is covered with small white flowers in panicles. The fruits are ripe in March to May, but may be earlier and may persist longer.

DISTRIBUTION & SILVICULTURE. D. guineense is found along the Transition Zone bordering the High Forest, in the Riverain Forest of the Savannah-Woodland, in the Coastal Scrub, and in riparian vegetation on the Volta near Ada. It is essentially a tree of the lower rainfall parts of the High Forest, where it is often associated with water courses.

FIELD NOTES. The following are some distinguishing features between these three species of Dialium.

	D.aubrevillei	D.dinklagei	D.guineense
Normal locality	Rain Forest	Moist Semi-Decid. Forest	Deriv. Sav.-Wood. & Coastal Zone.
Leaflets	5 alternate	5-8 prs.+1 term.	2 prs.+1 terminal
Pods	orbicular	globose	orbicular
"	glabrous	velvety	velvety.

7. DISTEMONANTHUS Benth.

Distemonanthus benthamianus Baill.

SYNONYM. D. laxus Oliv.

VERNACULAR NAMES. Bonsamdua (Ash,T,W). Duaanyan (F). Duabeyi (F). Duakobin (W). Ehuronvia (Nz). Ehurufren (Ao,S). Fawie (W). Kutreamfo (Ash).

TRADE NAME. Ayan.

A fairly large tree of 100 ft. or sometimes more in height and a girth of about 11 ft., although the average girth for mature trees is usually less. The bole is seldom straight and normally has a slight bend in it. The red bole is characteristic, and mostof the native names are derived from the bark features. Bonsamdua is devil's tree, duakobin is red tree and kutreamfo means the lizard cannot climb it - this is because of the smooth bark. For most of its life there are no buttresses. When these develop they are usually short, but occasionally bigger ones are found. The crown is light and rounded and tends to spread a little. The red bark is smooth but becomes scaly near the base of the trunk on older trees. When it peels off it leaves whitish irregular marks. The slash is thin, granular, light brown and interspersed with white in the inner layer. In the older trees there is a purplish tinge in the slash. The slash and yellow sapwood are conspicuously ripple marked. The heart is yellow, lustrous, moderately heavy (45 lb. per cu. ft. seasoned), fairly hard and reasonably durable. It has an interlocking grain, is acid resistant, and as flooring it wears well and evenly. It comes within the trade term of a satinwood, but is not being exploited in the Gold Coast (1952). In transverse section, many small vessels are visible and also bands of parenchyma of irregular length. The very fine and numerous medullary rays can be seen by means of a hand lens.

BOTANY. The pinnate leaves are alternate. There are normally from 7-11 alternate leaflets on each leaf. The leaflet is oblong-elliptic, from 2-5 in. long and $\frac{3}{4}$ - $1\frac{1}{2}$ in. broad, acuminate, more or less rounded at the base, dark shiny green above and pale dull green below, with a $\frac{1}{4}$ in. long petiolule. The midrib is raised below and the venation is reticulate. The rhachis, petiolules, underside of midribs and the young shoot are pubescent, but tend to become glabrous in time. The paired stipules, dark brown, pubescent, linear, 0.3 in. long, are caducous. The cymose flowers consist of 5 pink sepals, 3 white petals, 2 fertile stamens with porose dehiscence and 3 infertile, and a red tomentose superior ovary od one carpel. The flat, papery, pale brown pod is about $3\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. broad, has fine transverse lines on the outside, and contains from 1-4 seeds usually. The seed is olive brown, about 0.3 in. long and 0.2 in. broad, shiny, and with a very fine, hair-like

Distemonanthus benthamianus. 1.Leaf. 2.Pod. 3.Seed.
4.Seedling. All x 1. 5.Bole. 6.Tree.

funicle, 0.4 in. long.

PHENOLOGY. The tree is deciduous between August and December but is irregular. In September there may be trees with fruits and full crowns, trees with fruits and no leaves, and trees in full leaf and no fruits. It is often attacked by the semi-parasite Loranthus bangwensis Engl.& Krause, and its growths are prominent when the tree is deciduous. The coppery red or bronze flush produces a lovely effect. It remains coloured for some time and then changes to light green. The pink panicles of flowers are showy and are produced at varying times between November and April. The petals and stamens shower down on the ground. Ripe fruits are available from the end of July to October, but may persist unopened on the trees for some time after this. Very little fruit is produced, and very few trees bear fruit in any one year.

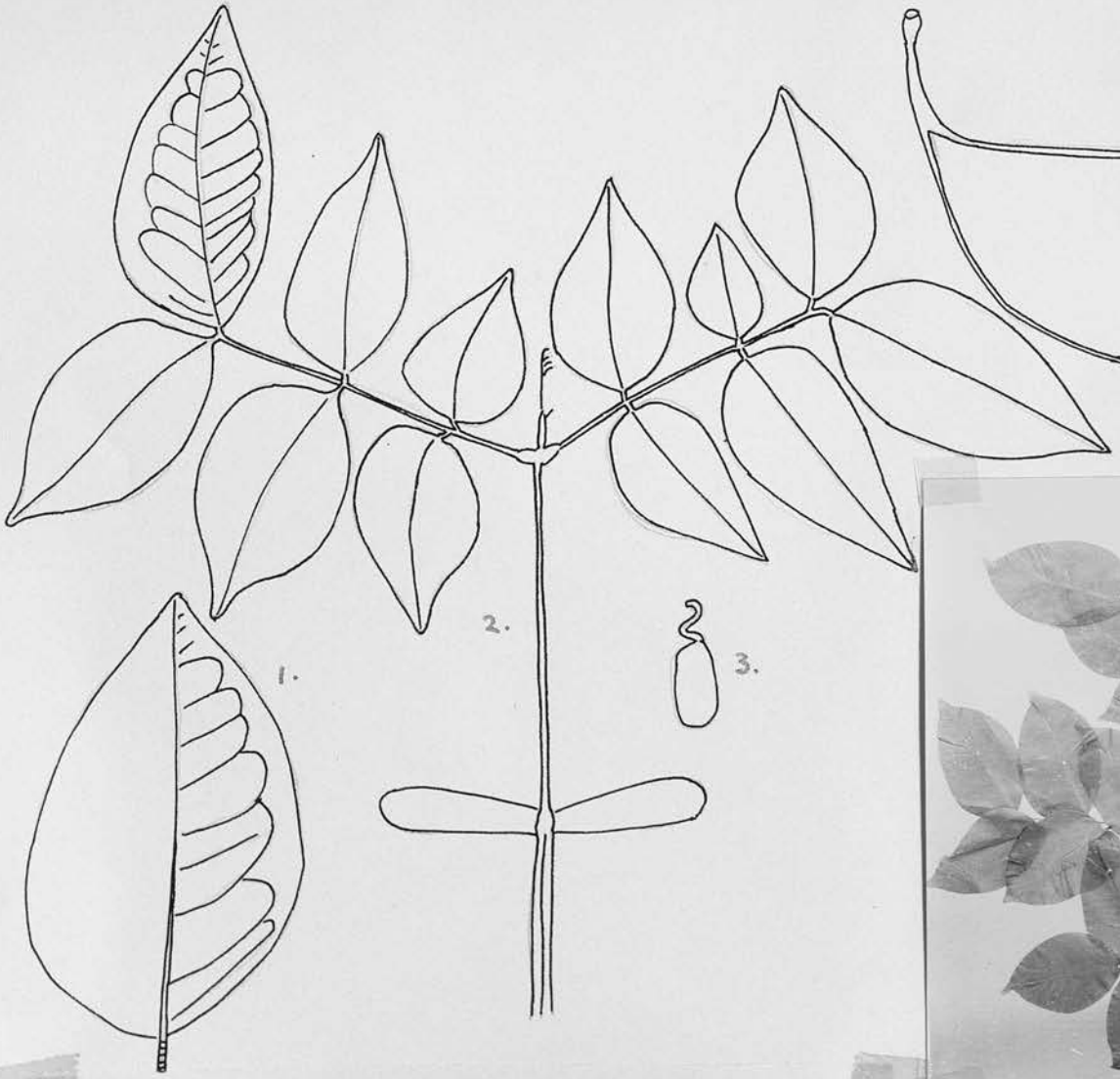
DISTIBUTION & SILVICULTURE. Distemonanthus is found throughout the High Forest Zone. It is usually infrequent, but is more common in the area east and south-east of Enchi than elsewhere. It does not appear to have any particular soil preferences. It will grow in Secondary Forest if the shrub layer is not too dense.

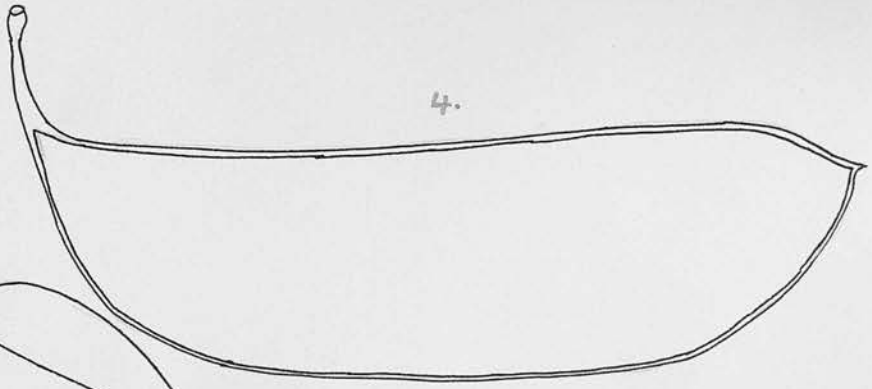
Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Subri	965	12	9	19	7	-
Fure	381	10	11	4	6	1
Yoyo	569	23	25	11	5	9
Bemu River	104	9	2	2	1	1
Oda River	436	45	17	8	8	1
Worobong	278	19	14	8	5	-

SEEDLING. Germination is epigeal. The hypocotyl is slender, light green to straw coloured and about $1\frac{3}{4}$ in. long. The cotyledons develop and become oblong, about 0.7 in. long and 0.3 in. broad, entire, with a rounded apex, broadly cuneate, sessile, thin and dull green. The firest two leaves are sub-opposite (probably alternate, but very close together) and about 0.2 in. above the cotyledons. Later leaves are alternate. The primary leaves are dark red, almost orbicular to deltoid in shape. The lamina is about $\frac{1}{2}$ in. long and broad, entire, rounded at apex and base, and becomes a light dull green. The very slender petiole is about 0.3 in. long. The shoot, petioles and undersides of the leaves are sparsely pilose.

ARTIFICIAL REGENERATION. There are about 540 seeds to an ounce. The germination percent is about 88.





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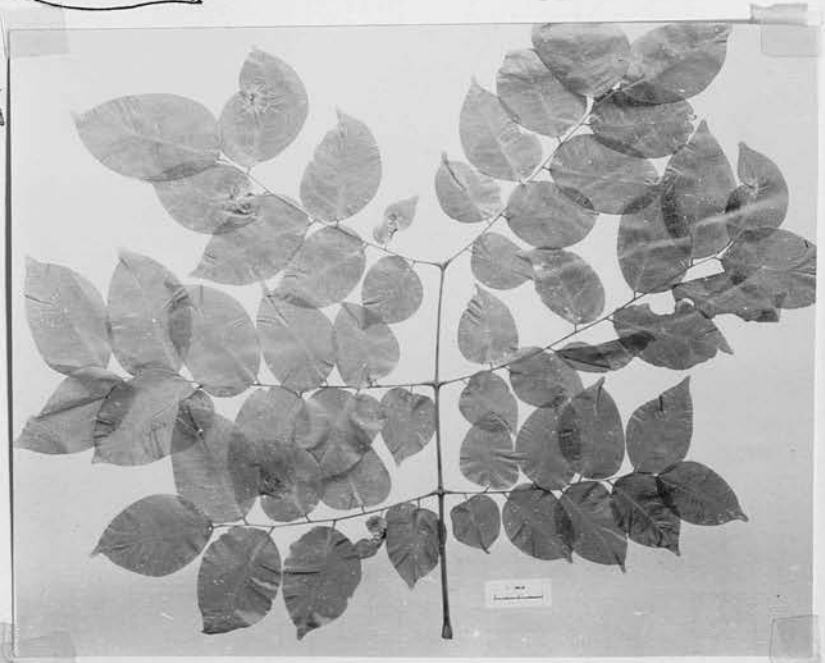


Erythrophleum guineense. 1.Leaflet. 2.Seedling.
3.Seed. 4.Pod. All x 1. 5.Leaf.

FIELD NOTES. See Afrormosia elata Harms.

ERYTHROPHLEUM Afz.

There are three Gold Coast species, one of which, E. africanum Harms, belongs to the Savannah-Woodland. Apart from its habit and habitat, it is easily disinguished from the other species by its smaller leaves, emarginate leaflet and narrower pod.

SPECIES. (i) E. guineense G.Don (ii) E. ivorense A.Chev.

These two species have similar morphological characters and are not easy to separate.

(i) Erythrophleum guineense G.Don

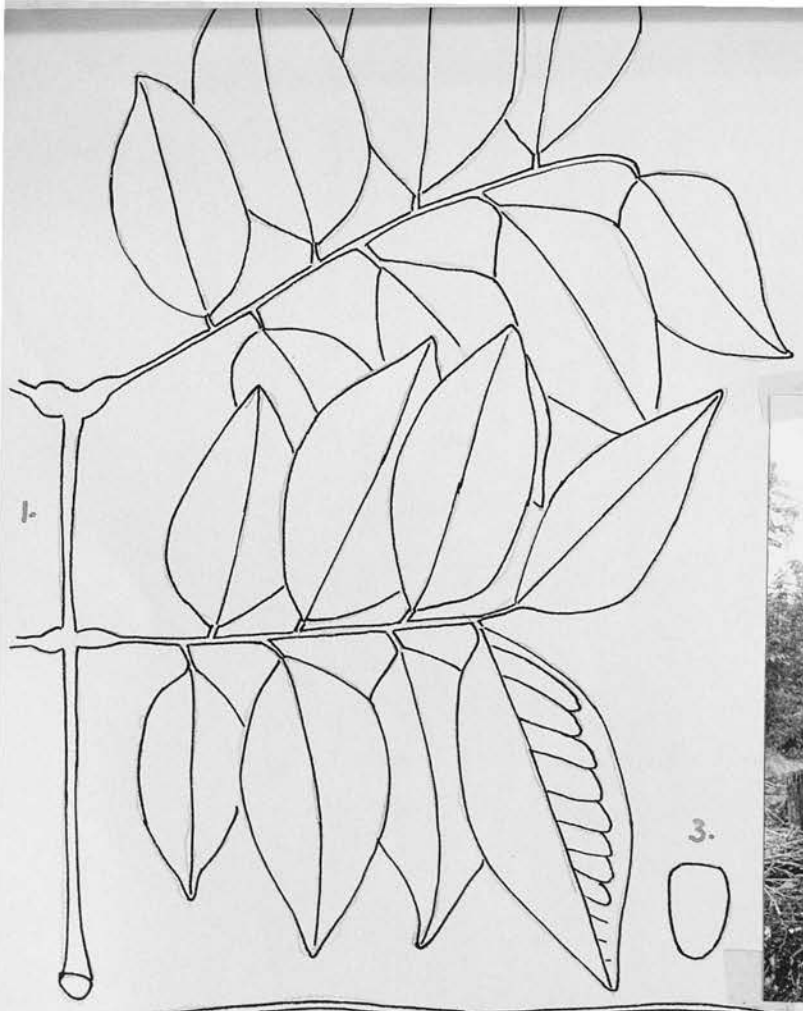
SYNONYM. Fillaea suaveolens Guill.& Perr.

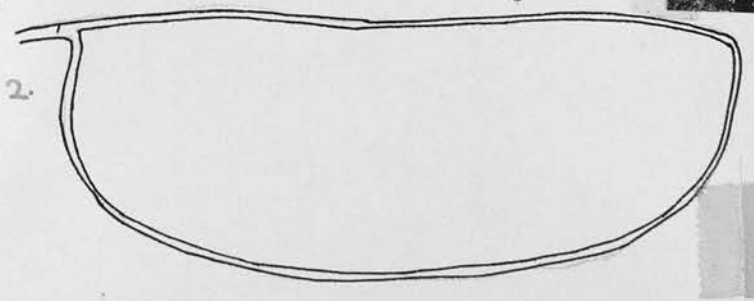
VERNACULAR NAMES. Etsa (E). Potrodom (Ash,T).
The Sasswood or Ordeal Tree.

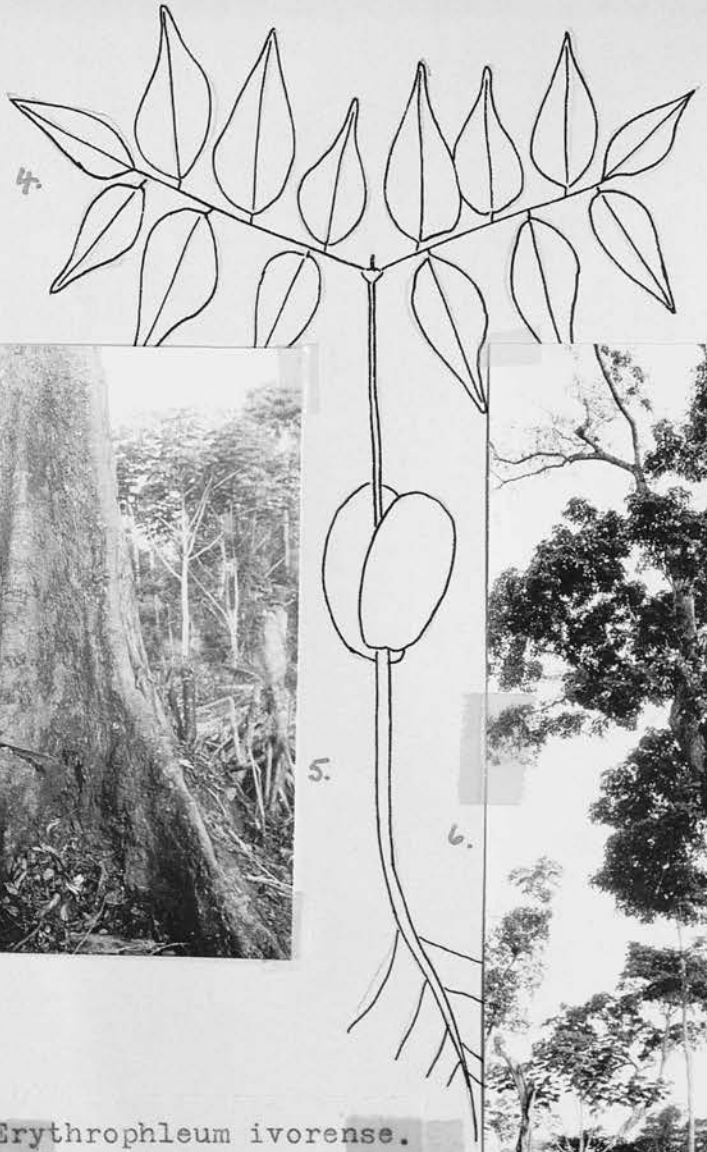
TRADE NAME. Tali.

A tree of 80 ft. or more in height and up to about 9 ft. girth B.H. It may reach a greater height, but quite often it is shorter, especially when growing in exposed situations. The stem is not straight. There are no buttresses. The crown is light and spreading and the branches are heavy. The bark is dark red-brown, scaly, rough and thick. The slash is granular, red, with irregular blackish marks in it, and slightly scented. Ripple marks are visible in the hard, white sapwood. The heart is reddish-brown, very hard and heavy, about 53 lb. per cu. ft. seasoned, dense, with an interlocking grain and coarse texture, difficult to work, and termite proof. The wood makes a good charcoal. The bark is poisonous, due to the presence in it of the alkaloid erythrophleine which is soluble in water. It was once used, and may be still, as a test by ordeal. The suspected person was given a drink of an infusion of the bark and if he survived he was considered innocent; if he died he was guilty! Innocence was usually due to vomiting expelling the liquid!

BOTANY. The large leaves are bipinnate, consisting of 2-4 pairs of opposite pinnae, and each pinna having from 7-12 alternate glabrous leaflets. The leaflet is ovate-elliptic, 1-3 in. long and 1-2½ in. broad, obtusely acuminate, with a rounded base and a slender, dark petiolule about 0.2 in. long. The small yellow-white flowers are in terminal panicles and appear catkin like. There are 5 sepals, 5 petals, 10 stamens and a superior ovary of 1 carpel. The pod is about 4½ in. long and 1¼ in. broad, flat, thin, slightly woody, with a short, sharp beak atthe apex. There are from 5-10 black seeds, each with its long, curled up, brown funicle. The seed is about 0.5 in. long and 0.3 in. broad.







Erythrophleum ivorense.
1.Leaf. 2.Pod. 3.Seed.
4.Seedling. All x 1.
5.Bole. 6.Tree.

seasoned, very hard, dense, with an interlocking grain, coarse texture and is rather difficult to work. It is durable and termite proof. The wood has been used for harbour works, railway sleepers and bridges, but has no market value in the Gold Coast at present (1952). The bark is said to be less poisonous than that of E. guineense and to fail as a fish poison.

BOTANY. The bipinnate leaves have 2-4 pairs of pinnae and there are 4-6 pairs of alternate leaflets to each pinna. The leaflet is narrowly elliptic, about 2 in. long and 0.9 in. broad, entire, acuminate, with a rounded unequal sided base, dark green and glabrous. The midrib is prominent on the underside but the nerves are barely visible. The petiolule is short and grooved on the upper side. The very small flowers are borne in panicles. There are 5 reddish-brown, densely pubescent sepals, 5 golden brown, densely pubescent petals, 10 yellow stamens (sometimes 5 long and 5 half the length) and a superior ovary of 1 carpel. The pod is flat, about 4 in. long and 1½ in. broad, slightly woody. thin, dark brownish-black, and if beaked, only slightly so.

PHENOLOGY. Flowering may begin in June, but is at its peak in August-September, when the crown of the tree is covered with the terminal panicles. Ripe pods are obtainable from March to July, but they may remain on the trees for some time afterwards. The pods open on the trees, and the seeds remain attached to them. In wet weather the pods may fall unopened. Distribution of the seed is poor as most of it drops near the mother trees. The halves of the pod are not light enough to be blown far. It has been observed in the Subri F.R. that in September, trees with the previous season's fruits still on them, do not flower thatyear. Similarly, those in flowere are without old pods. Perhaps the individual tree flowers and fruits periodically - perhaps every second year.

DISTRIBUTION & SILVICULTURE. E. ivorense is scattered throughout the High Forest Zone, but avoids the Transition Zone with the Savannah-Woodland, which is the habitat of E. guineense. It is more common in the Rain Forest than in the Moist Semi-Deciduous Forest. It grows right down to the sea where there is forest - e.g. near Cape Three Points. In 1912, T.F.Chipp recorded a specimen a few yards from the sea at Axim. Because of its bad shape, it is a bad tree silviculturally, and in concentrated natural regeneration works this species should be eradicated. Big trees die readily with standard poisoning practice, using an aqueous solution of sodium arsenite.

Frequency figures obtained from enumeration surveys are as follows:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Cape Three Points	129	2	3	1	2	1
Subri	965	29	31	35	35	12
Fure	381	2	8	21	16	6
Yoyo	569	1	5	3	1	9

SEEDLING. Germination is epigeal. The hypocotyl is about 1½ in. long, brown, woody, and with a rectangular section. The cotyledons enlarge but are not foliaceous. They are green, oblong, about 1 in. long and ½ in. broad, entire, with a rounded apex and auriculate base, and sessile. The shoot is green. The first two leaves are about 1¾ in. above the cotyledons and are opposite. The leaf consists of three pairs of opposite or sub-opposite leaflets. These are dark red at first, elliptic (½ in. long and 0.2 in. broad on the 3rd. day after germination), entire, acuminate, rounded at the base and with a short petiolule. Later leaves are alternate. The shoot and rhachis bear a fine pubescence.

NATURAL REGENERATION. Considering the quantity of sed produced, there is little regeneration.

9. GUIBOURTIA

This genus contains trees which yield gum copal, and have hard, heavy timbers which may be striped. The name Bubinga is applied to more than one species in the timber trade - in fact, to other genera as well.

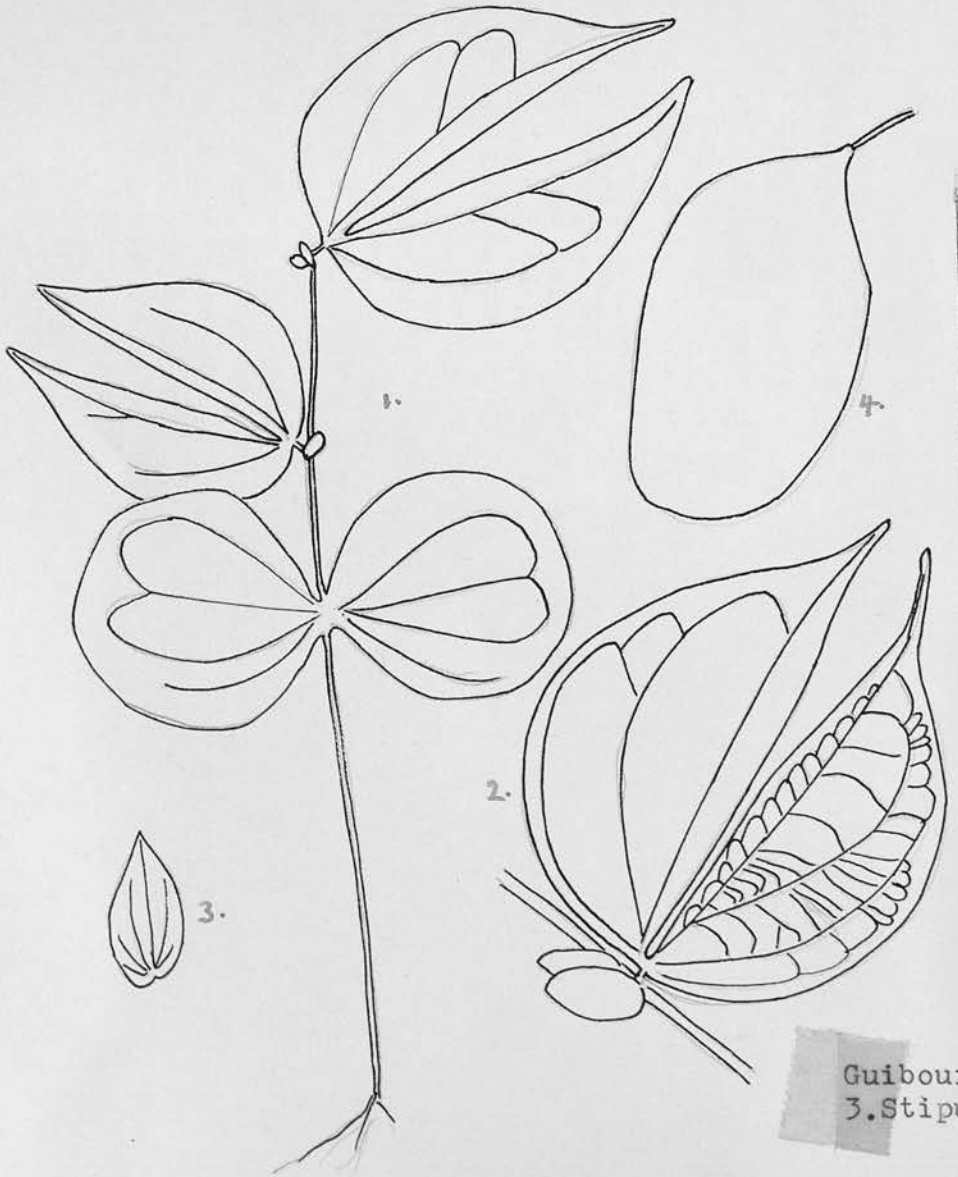
SPECIES. (i) G. ehie (A.Chev.) J.Leonard (ii) G. salikounda (Copaifera salikounda Heckel)

(i) Guibourtia ehie (A.Chev.) J.Leonard

SYNONYM. Copaifera ehie A.Chev. ex Bak.f.

VERNACULAR NAMES. Anokye (Ash). Anokye-hyedua (Ash). Hyeduanini (Ash). The name Hyedua is also used, but incorrectly - see Daniellia similis.

A tall tree but usually not of great girth. A specimen in the Tano-Suhien F.R. had an estimated height of 150 ft. and a measured girth above buttresses of 11 ft. 6 in. More often the tree is about 100 ft. high and 8 ft. girth. A felled tree, which from a ring count might have been 61 years old, had a diameter of 22.5 in. The bole is cylindrical and buttressed up to about 12 ft. high. The crown is quite large, but not spreading. The light grey bark is fairly smooth. The slash is hard, thick,



Guibourtia ehie. 1.Seedling. 2.Leaf. 3.Stipule. 4.Pod. All x 1. 5.Bole. 6.Tree.

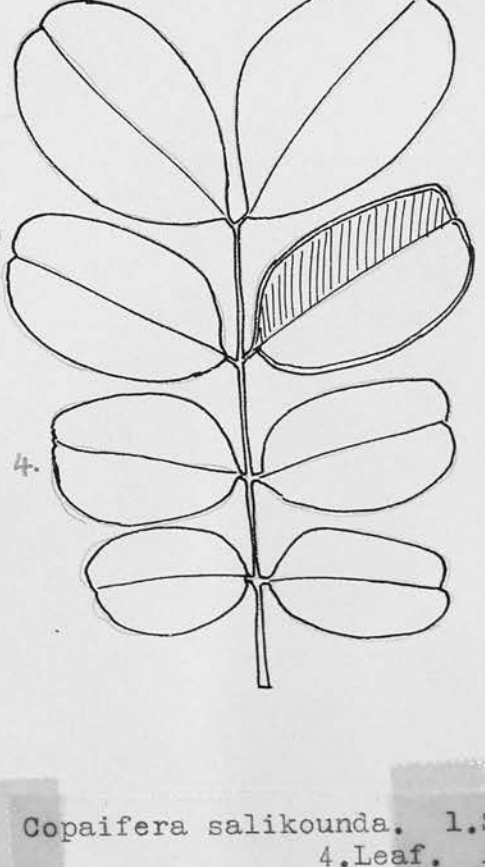
granular, dull pinkish-brown and sometimes exudes a sweet smelling gum. The hard, white sapwood has a silky lustre. On the older boles there is a tendency for "rings" to be formed, not unlike those of Daniellia similis, but less prominent. The heart is dark brown with vertical black veins, very hard and heavy, and when fresh smells strongly of an over-ripe oily cheese. There is a tendency to "silver grain" on the radial surface. In transverse section many small vessels can be seen, each surrounded by a thin ring of parenchyma. The medullary rays are very fine, numerous and just visible. Growth rings are apparent as darker tissue. This is one of the copal bearing trees (thus the former generic name of Copaifera), and gum can be found sometimes collected at the base of the tree in the ground.

BOTANY. The compound leaf sonsists of a pair of sickle shaped leaflets and a short petiole, subtended by a pair of green, foliaceous stipules which are oblong-lanceolate to oblong-elliptic, up to about 0.8 in. long and 0.4 in. broad, veined and with ciliate margins. The leaflet is about 2½ in. long and 1 in. broad, entire and with a long acuminate tip. There are two principal basal nerves and the midrib is close to the inner margin. The pellucid glands are small and confined to the margin of the leaflet. The branchlet, petioles and undersides of the nerves are pilose. The flowers are small, white and scented, and are borne in terminal panicles. There are 4 sepals, no petals, 10 stamens and a superior ovary of 1 carpel. The fruit is a 1 seeded flat, brown, veined and rather membranous pod, with a rounded apex.

PHENOLOGY. Flowering takes place in September and October. The pods develop quite quickly and ripe seed may be obtained in December and January. A 1 ft. G.B.H. tree has been observed in flower. Sapling leaves have a red flush.

DISTRIBUTION & SILVICULTURE. G. ehie has a definite distribution in the Gold Coast; it appears to be confined to a triangular area with its base between Enchi and the Pamu-Berekum F.R. and its apex about 34 miles west of Kumasi. It is sometimes found growing semi-gregariously and is tolerant of shade. It is a constituent of the upper canopy.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, woody and blackish. The cotyledons develop and are almost orbicular, with a diameter of about 1½ in., but bulging slightly to one side. They are 3-nerved from the base, with an extra nerve on the more developed side. The leaves are alternate, the first one being about 2 in. above the cotyledons. The leaf has a short petiole and a pair of opposite, sickle shaped leaflets. In the first leaf the leaflet is about 1½ in. long and 0.6 in. broad, acuminate, 2-nerved from the base, with the midrib near the inner side. The leaf is subtended by a pair of green, foliaceous, oblongolanceolate stipules. The margins of the leaflet abd the stipules contain pellucid glands. There



Copaifera salikounda. 1.Seedling. 2.Pod. 3.Seed.
4.Leaf. All x 1. 5.Bole.

are a few weak hairs on the stem and underside of the leaf midribs.

NATURAL REGENERATION. This is usually profuse under the mother tree. The seedling prefers shaded conditions in the forest, and is not normally found in young Secondary Forest. Its rate of growth is slow.

FIELD NOTES. See Cynometra ananta and Daniellia similis.

(ii) (Guibourtia salikounda) Copaifera salikounda Heckel

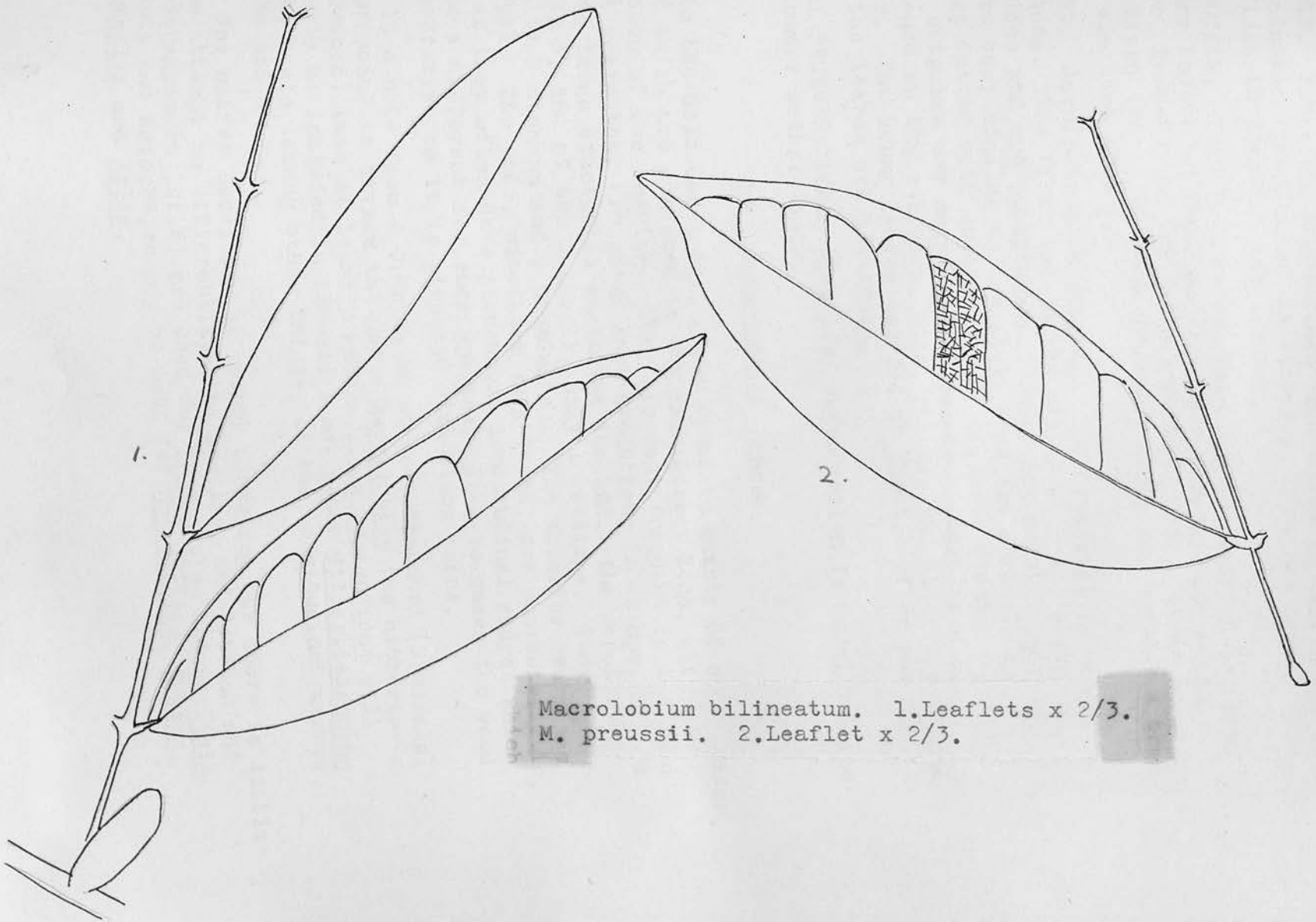
J. Léonard's revision of Copaifera L. (1949) retains the name Copaifera salikounda Heckel

SYNONYMS. Copaifera salikounda Heck. Detarium chevalieri Harms

VERNACULAR NAMES. Akuaama (W). Amuaka (D). Entedua (Ash) Oprimo (T).

A large tree. A specimen felled hear Kumasi measured 152 ft. high (bole 105 ft., crown 47 ft.), 9 ft. 6 in. G.B.H., and a girth at 52 ft. of 6 ft. 10 in. Other specimens have B.H. girths of 22 ft. 6 in. (Asenanyo F.R.) and 16 ft. 9 in. (Subri F.R.). The bole is clear and cylindrical. There are no buttresses, but root spurs may develop in old trees. The crown is not dense although it is fairly large. The branches are ascending. The bark is dark, rough, vertically fissured in strips about 1 in. wide; in the very old trees it becomes flaky. The slash is dark brown through the corky layer, then light pink-brown. It is sweet smelling - a slightly oily scent - and a sticky gum exudes. The sapwood is white and the heart reddish-brown and very hard. In transverse section the scattered vessels are hardly visible. The ring of parenchyma around each can be seen with a hand lens, and also the fine, numerous medullary rays which are a different shade of red from the rest of the wood. There is a decided band of parenchyma at the end of each growth ring.

BOTANY. The paripinnate leaves consist of usually 4-6 pairs of opposite leaflets which are shiny on both sides. The leaf is about 4 in. long. The leaflet is oblong, about 1.2 in. long and 0.5 in. broad, entire, emarginate, unequal sided and rounded at the base. The yellow midrib is raised below; the nerves are very fine. There is a semi-transparent marginal nerve which is somewhat ciliate. The pellucid glands of the young leaves disappear in time. The petiolule is very short. The rhachis is channelled above. It and the petiolules, the underside of the midribs and the branchlets are sparsely covered with a light brown pubescence. The small paniculate flowers consist of 4 sepals, no petals, 10 stamens of unequal length, and a superior ovary of 1 carpel. The fruit is a flat, oval pod, about 1½ in. long and 1 in. broad, rounded, dehiscing along both margins, and containing a small, black, oval seed, about ¼ in. long and covered by a pink, fleshy aril which dries to form a membranous wing around the seed.



Macrolobium bilineatum. 1.Leaflets x 2/3.
M. preussii. 2.Leaflet x 2/3.

PHENOLOGY. Flowering takes place from March to May. Ripe fruits are obtainable from October to February. The new leaves have a red flush in December and January.

DISTRIBUTION. This High Forest Tree may be regarded as rare. Specimens have been recorded from near Kumasi, the Bobiri, Asenanyo, Tano-Suhien, Pra-Anum and Subri F.Rs. It is apparently a long lived tree. It develops under shade but becomes a tree of the emergent canopy.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long. The first two leaves are about 2 in. above the cotyledons and are paripinnate. There are about 5 pairs of leaflets very similar to the adult ones but more elongate. They are dotted with numerous small pellucid glands. The paired stipules are narrowly lanceolate. There is a slight pubescence on the stipules, stem, rhachis and underside of the midribs. The young leaves are red at first. After the first pair, the leaves are alternate.

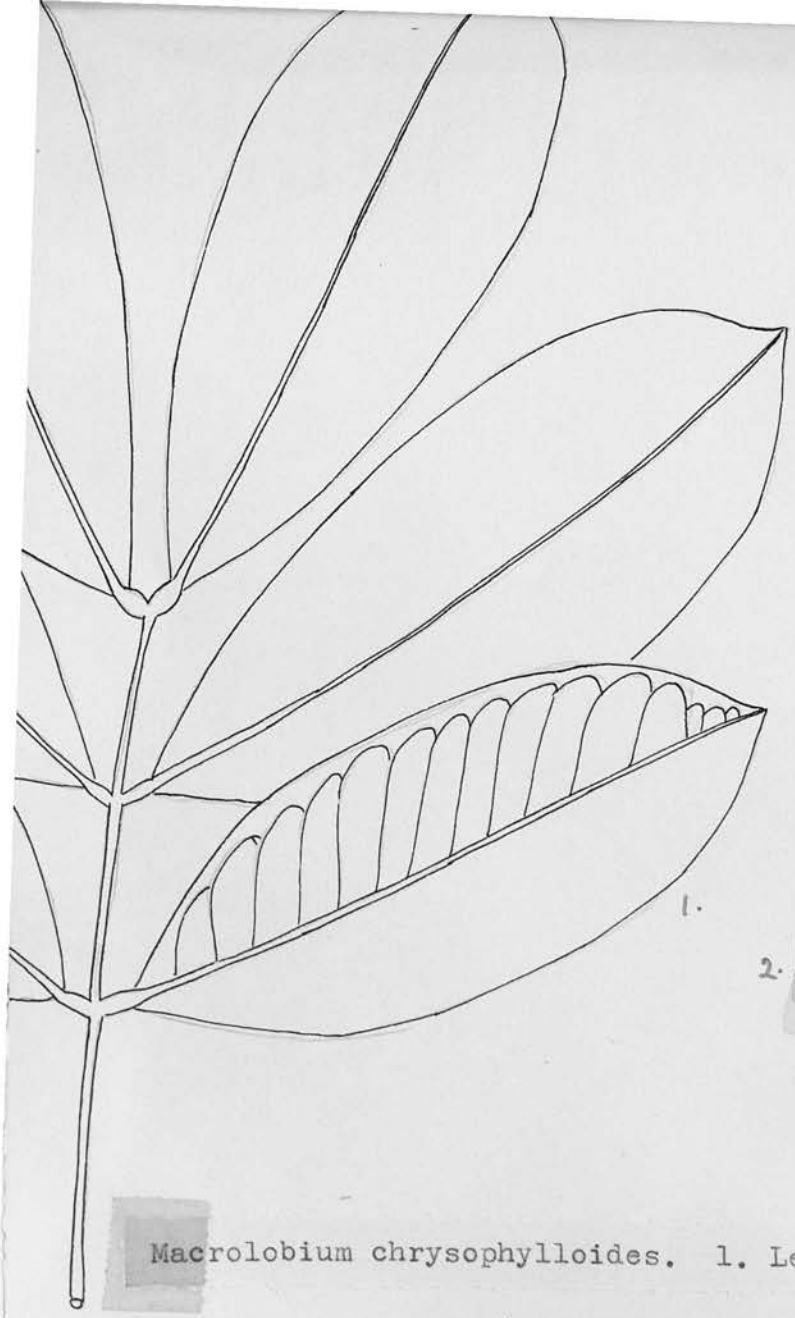
NATURAL REGENERATION. Plentiful regeneration is usually to be found under mother trees.

10. MACROLOBIUM Schreb.

In the Gold Coast this genus consists mainly of small trees, all of which are confined to the High Forest Zone, with the exception of one species. They are most frequent in the Rain Forest where they are often semi-gregarious in swamps. There are two large bracteoles enclosing the bud. The sepals are usually 5, and of the 5 petals, only 1 develops. There are normally 3 stamens and 6 staminodes. The superior ovary has 1 carpel. The pods, sometimes very large, are characteristic, in that they often have pronounced longitudinal ridges which assume a different for each species. In some cases the wood is decorative as it is streaked with black veins.

In a note from A.C.Hoyle he states, "Léonard (Brussels) has proposed to divide the genus Macrolobium (as hitherto understood) into at least 3 genera.....M. splendidum will probably be included in Léonard's new genus Gilbertiodendron on the basis, among other things, of the longitudinal nerves on the pod."

The native names may be rather confusing, as there is little or no attempt to differentiate the species, and Tetekon and Tetekonagyemera (Nz,W) are used for Macrolobium and Berlinia. Samanta and Kotoprepre may be used for Macrolobium, Bussea, Calpocalyx and Xylia.



1.

2.

3.

Macrolobium chrysophylloides. 1. Leaf x 1. 2.Bole. 3.Tree.

SPECIES. (i) M. bilineatum Hutch.& Dalz. (ii) M. chrysophylloides Hutch.& Dalz. (iii) M. diphyllum Harms (iv) M. limba Scott Elliot (v) M. macrophyllum Macbride. (vi) M. preussii Harms. (vii) M. splendidum Pellegr. (viii) M. vignei Hoyle.

(i) Macrolobium bilineatum Hutch.& Dalz.

VERNACULAR NAME. Kotoprepre (W).

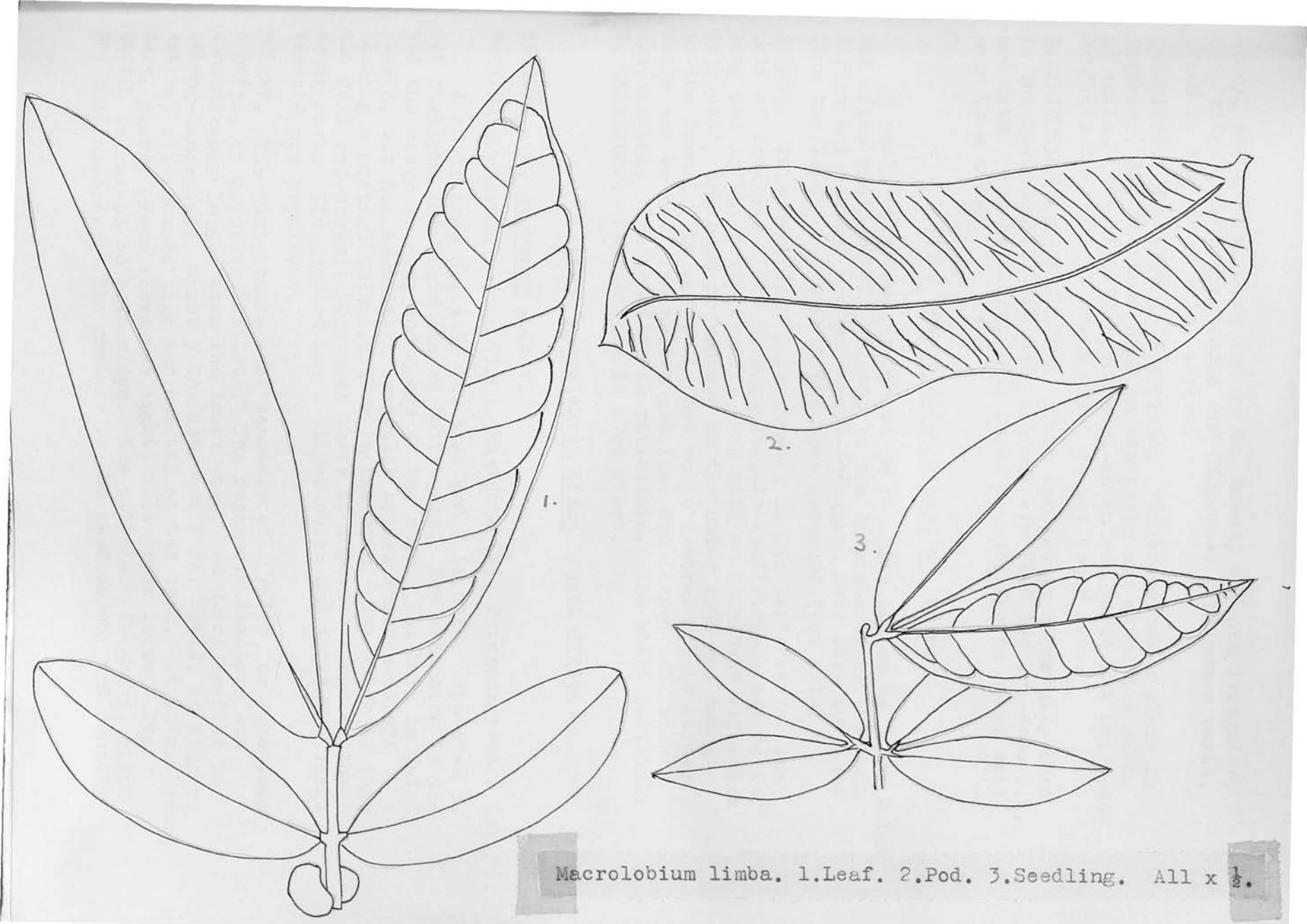
A tree of the lower storey in the High Forest, similar in appearance to M. limba. It has been recorded in wet places at Enchi as a tree 70 ft. high and 6 ft. G.B.H. The wood is hard, fairly heavy and dull brown.

BOTANY. The leaves are about 10 in. long, paripinnate, consisting of 5-8 pairs of opposite leaflets. The stipules are about 1½ in. long, lanceolate and persistent, and they may have reniform appendages at the base. The leaflet is narrowly oblong to slightly oblong-lanceolate, about 8 in. long and 2½ in. broad, glabrous, entire, with a short acumen or acute, and cuneate at the base. The midrib is raised above and below; the nerves are very fine and the venation is reticulate. The petiolules are short and thickened. The pod is about 6 in. long and 1¼ in. broad, with two longitudinal ridges.

(ii) Macrolobium chrysophylloides Hutch.& Dalz.

This is one of the biggest Macrolobiums. A tree in the Pra-Anum F.R. has an estimated height of 90 ft. of which 60 ft. is bole, and a measured G.B.H. of 11 ft. 4 in. Another at Axim was estimated at 110 ft. high and 8 ft. G.B.H. The bole is straight and not buttressed. There may be short root spurs in old trees, affecting the shape of the bole for about 5 ft. The crown is dense, compact and not big. It is dark, but appearing golden brown from below. There are grey, fairly smooth, irregular flakes on the bole. The slash is moderately thick, dull red-brown. The fairly hard white sapwood has a slight sheen. In it the numerous fine ripple marks and the prominent vessels can be seen. There is a delayed exudation which is slightly sticky and looks like sweetened condensed milk. The heart is yellowish with dark veining. In transverse section, the elliptical parenchyma surrounding each vessel is very conspicuous. Growth rings are apparent. The numerous fine medullary rays can be seen with a hand lens.

BOTANY. The leaf is paripinnate, about 9 in. long or bigger, with 3 pairs of opposite leaflets. The leaflet is oblong-lanceolate, about 5 in. long and 1½ in. broad, but sometimes bigger. It is entire, bluntly acuminate, cuneate or almost rounded at the base, and with a short, swollen petiolule. The venation is reticulate. This species is conspicuous because the underside of the leaflet is covered with golden tomentose hairs. The flowers are small. The pod is dehiscent, woody, about 5 in.



Macrolobium limba. 1.Leaf. 2.Pod. 3.Seedling. All x $\frac{1}{2}$.

woody, about 5 in. long and 1½ in. broad, and has irregular, deep ridges, both transverse and diagonal. The brown seeds, often 3, are about 1 in. across.

PHENOLOGY. The tree is evergreen. Flowering takes place in December, and the pods open on the trees and expel the seeds in April. The sapling has a semi-pendulous habit and the young leaflets are a light shiny green on the upper side.

DISTRIBUTION & SILVICULTURE. This species is apparently rare in the Gold Coast. The only records are from the Pra-Anum F.R. and Axim. In the former, the trees are growing in heavy soil near to a swamp.

(iii) Macrolobium diphyllum Harms

A small tree, usually about 30 ft. high and up to 3 ft. G.B.H but often smaller. It belongs to the understorey of the Rain Forest and nearby, and is rare. Specimens have been obtained from the Yoyo F.R., and it has been recorded from Axim.

BOTANY. This Macrolobium is unusual as its leaf has but one pair of leaflets. The oblong-elliptic leaflet is about 5½ in. long and 1½ in. broad, entire, and with an acuminate tip which is hooded; the base is rounded on the outer side and cuneate on the inner. The midrib is not quite central and is raised above and below. The nerves are fine and looped well within the margins. The venation is reticulate. The short petiolule is thickened. The petiole is also short.

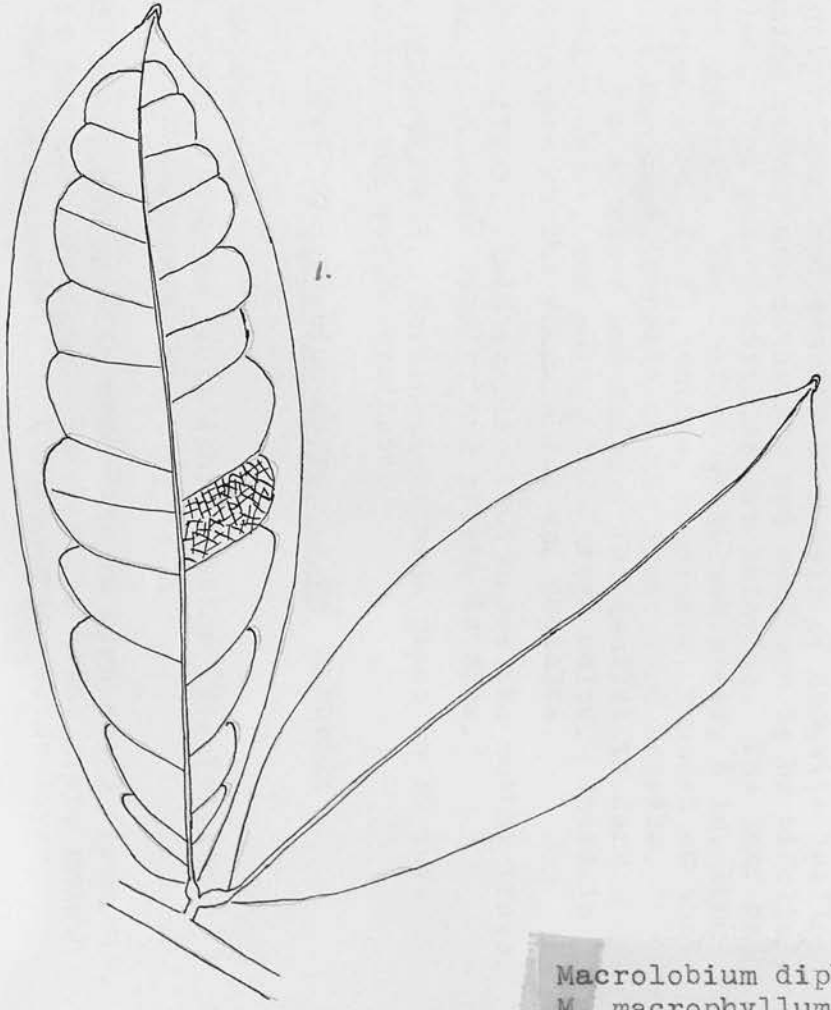
(iv) Macrolobium limba Scott Elliot

SYNONYM. M. ivorense A.Chev.

VERNACULAR NAMES. Afanu (Ash). Kusipapa (W). Tetekonagyemera (Nz,W).

A small tree about 50 ft. high and 7 ft. GBH. The stem is not straight and there are no buttresses. The branching is low and the crown is deep and close to the stem. The bark is fairly smooth, but has some light irregular scales which peel off leaving a mustard coloured mark on the stem. The slash is thin and dull red-brown. Sometimes there is a purple tinge in the inner bark. The sapwood has a slight sheen and in it the large vessels are prominent.

BOTANY. The paripinnate leaf consists of 2 pairs, or sometimes 3 pairs, of opposite leaflets. The uppermost leaflets are considerably larger than the lower ones. An upper leaflet is oblong-lanceolate, about 9 in. long and 2 in. broad, or bigger, entire, with obtuse tips and unequal at the base. It is glabrous, dark, glossy green above and light, dull green below. The midrib is raised on both sides. The petiolule is short, stout and reddish-brown. The rhachis is the same colour and densely



Macrolobium diphyllum. 1. Leaf x 1.
M. macrophyllum. 2. Branchlet.

pubescent. Adjacent to the small stipules are rounded or reniform appendages. The flowers are subtended by bracteoles. There are 2 thick sepals, white on the inside and pink and pubescent on the outside. The developed standard petal is about 1¼ in. broad, white on the inner side and pink on the outer, and deeply cut in the middle. The 3 red filaments have big anthers with prominent longitudinal slits. The superior, unilocular ovary is covered with a brown pubescence and the red style is long. The brown woody pod may be up to 10 in. long and 3 in. broad, and has a prominent ridge along the middle of each side, and numerous, minor, diagonal ridges.

PHENOLOGY. The tree is evergreen. Flowering takes place in March and April, and the pods are ripe towards the end of July until September. They are dehiscent.

DISTRIBUTION & SILVICULTURE. This species is found growing gregariously in the High Forest Zone in swamps and in wet depressions in heavy soil which are partial swamps and never really dry. It has not been recorded from the Rain Forest. It may be the Moist Semi-Deciduous Forest counterpart of M. splendidum.

SEEDLING. Germination is epigeal. The hypocotyl is usually about 1½ in. long, but may be very short with the cotyledons appearing just above ground. The shoot is woody and dark brown. The first two primary leaves are opposite, about 5 in. above the cotyledons, and consist of a pair of opposite leaflets. The succeeding leaves are alternate and continue to be bifoliate for some time. The paired stipules are acicular. The leaf has a very short petiole. The leaflet is oblanceolate, 6 in. long and 2 in. broad (3rd. leaf), entire, acuminate, rounded on the outer side at the base, cuneate on the inner, and sessile. The midrib is raised above and below. The leaflet is dark green and shiny above, and paler, dull green below. There is a rusty pubescence on the young shoot and petioles.

NATURAL REGENERATION. This is plentiful under the mother trees. The seedling is a shade bearer, and growth is slow.

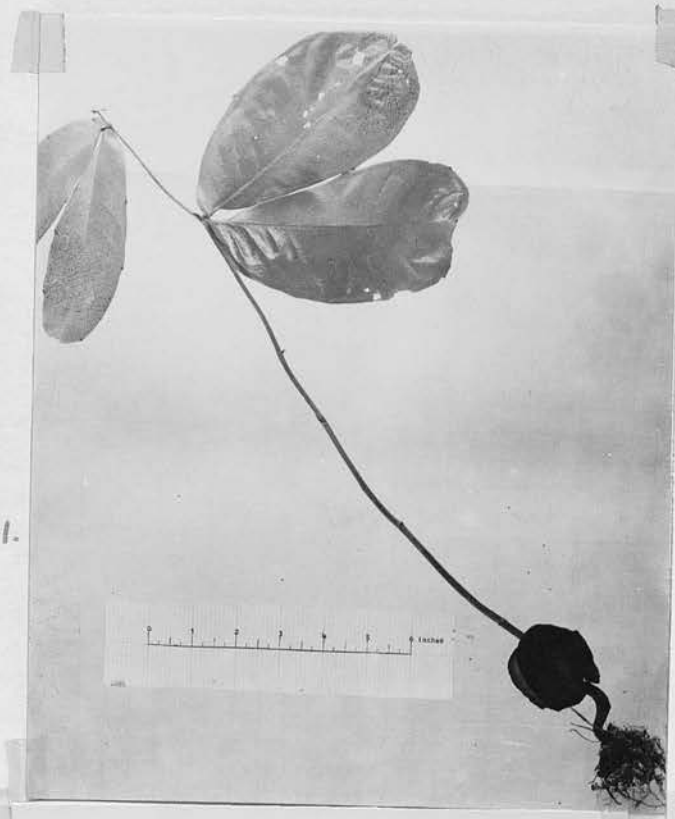
ARTIFICIAL REGENERATION. Germination takes place in 10 days and about 83% of the seeds germinate.

(v) Macrolobium macrophyllum Macbride

SYNONYM. M. palisoti Benth.

VERNACULAR NAMES. Nsuroko (West Ash). Tetekon (W). Tetekon-agyemera (W).

A small tree, not usually exceeding 40 high and 3 ft. G.B.H. The crown is low and spreading. The bark is light grey, smooth and thin. The slash consists of a thin, green outer layer,



Macrolobium splendidum.
1.Seedling. 2.Leaf.
3.Pods. 4.Tree.

a thin, yellow middle layer and a thin, white inner layer. The sapwood is hard, white and has a sheen.

This species is widespread as a lower stoey tree of the High Forest and the Riverain Forest of the southern Savannah-Woodland.

BOTANY. The paripinnate leaves consist of 3-4 pairs of opposite leaflets. The leaves are variable in size, even on the same tree. The leaflet is broadly oblong-lanceolate to elliptic, and varies from 3-9 in. long and 1-4 in. broad. The midrib is raised below, the nerves are few and fine and the venation is reticulate. The underside of the leaflet is covered with close, silky hairs, giving it a silvery appearance. The yellow flowers are in panicles. The woody, brown, flat pod is up to about 12 in. long and 3 in. broad and has many diagonal, irregular, shallow ridges on the outside.

PHENOLOGY. The tree is evergreen. Flowering takes place between August and September or October, and the pods are ripe from March to May, or sometimes earlier. The new leaves are pendulous and light green.

(vi) Macrolobium preussii Harms

VERNACULAR NAMES. Kusipapa (W). Tetekon-agyemera (W).

Usually a small tree, about 40-50 ft. high and 5 ft. G.B.H. but one specimen has been recorded with an estimated height of 100 ft. and 7 ft. G.B.H. The crown is spreading and the bark yellow and scaly. It occurson river banks in the Rain Forest where it is often gregarious. Flowering has been observed in November and December.

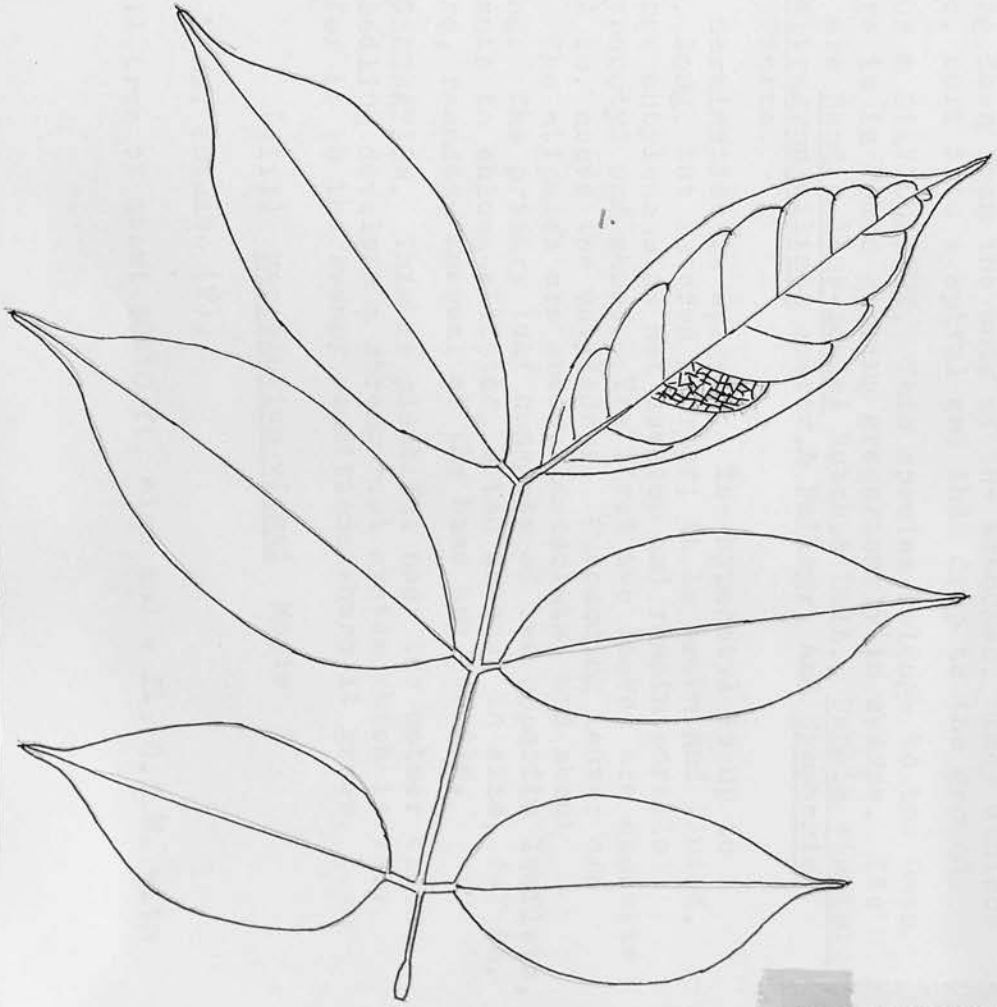
BOTANY. The paripinnate leaves consist of usually 3-4 pairs of opposite leaflets. The leaflet is oblong-lanceolate, up to about 8 in. long and 2 in. broad, entire, acuminate, broadly cuneate to almost rounded at the base, and a short, slightly thickened petiolule. The midrib is raised above and below, and the venation is reticulate. The standard petal is yellow.

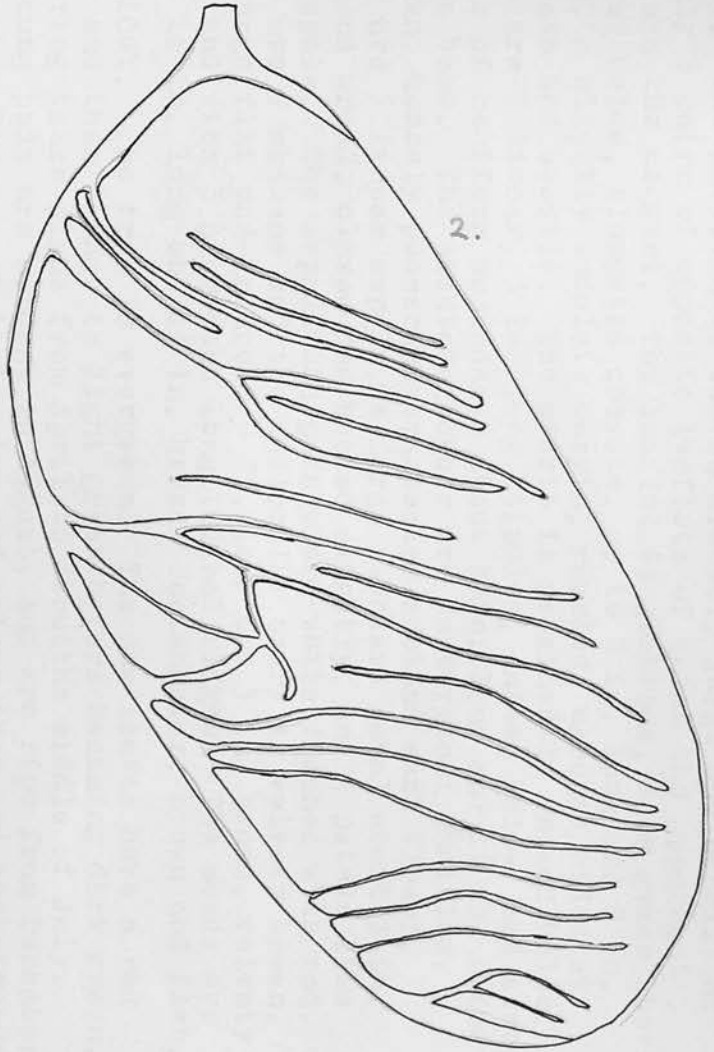
(vii) Macrolobium splendidum Pellerg.

SYNONYM. Berlinia splendida A.Chev.

VERNACULAR NAMES. Kotoprepre (W). Kusipapa (W). Tetekonagyemera (W).

A tree, not usually exceeding about 70 ft. high and 7 ft. G.B.H. The bole is slender and is not buttressed. The tree is rather untidy looking with its deep crown of very large, pendulous leaves close to the stem. The bark is fairly smooth, with flat scales and scattered small, brown lenticels. The slash is thin, hard, granular and dull red-brown. The hard, white sapwood has a sheen and the large vessels are prominent. The heart is red-brown and hard.





Macrolobium vignei. 1.Leaf underside x 2/3.
2.Pod x 1.

BOTANY. The paripinnate leaves are very large and consist of usually 3 pairs of opposite leaflets of which the uppermost ones are the biggest. The leaflet is glabrous, dark green above, lighter below, elongated obovate, up to 2 in. long and 8 in. broad, a slightly undulate margin, rounded, unequal sided at the base and sessile. The midrib is prominently raised below. There are 2 linear, 3 in. long stipules, united below, and also a pair of reniform appendages about 2 in. long and 1½ in. broad at the base. The scented flowers are in terminal panicles. 2 brown, densely pubescent bracteoles subtend each flower. There are 5 linear sepals, a large standard petal about 5 in. long and broad, clawed and hooded slightly, and 4 petals like the sepals. The sepals and petals are white flushed with red. There are 9 stamens and the unilocular ovary is velvety brown. The large flat pod is about 2 ft. long and 5 in. broad, velvety brown and with 3 prominent longitudinal ridges. The seeds are about 1¾ in. long and 1¼ in. broad, rectangular, brown and flat.

PHENOLOGY. The tree is evergreen. The new leaves have a red flush and then change to light green before becoming dark green. Flowering takes place from April to aboutthe middle of July. The young pods are evident in August, and are ripe from December to March. Because of their size and colour they are conspicuous as they hang down from the ends of the branches. They dehisce on the tree, curl into a spiral and then drop to the ground.

DISTRIBUTION & SILVICULTURE. This species belongs to the Rain Forest where it is found growing gregariously in swamps. Its associates are Randia lane-poolei Hutch.& Dalz., Raphia vinifera P.Beauv., Mitragyna ciliata Aubrev.& Pellegr. and Symphonia gabonensis Pierre.

SEEDLING. Germination is epigeal. The hypocotyl is up to about 4 in. long, but is ofen shorter; it is brown and fluted. The two large cotyledons do not develop and remain parallel with the hypocotyl and shoot. The first two leaves are opposite and about 4 in. above the cotyledons. Succeeding leaves are alternate. The stipules are green, lanceolate, and about 0.3 in. long. The primary leaf consists of two opposite leaflets, oblong-obovate to oblong-elliptic, often unequal in size, 4-7 in. long, entire, rounded, unequal at the base and sessile.

NATURAL REGENERATION. This is plentiful near the mother trees. The young sedling develops a strong root system which is very necessary for it in the swampy conditions where it grows.

(viii) Macrolobium vignei Hoyle

VERNACULAR NAME. Tutuabo (W).

A small tree of about 40-50 ft. high and 4 ft. G.B.H. with

BOTANY. The paripinnate leaves are very large and consist of usually 3 pairs of opposite leaflets of which the uppermost ones are the biggest. The leaflet is glabrous, dark green above, lighter below, elongated obovate, up to 2 in. long and 8 in. broad, a slightly undulate margin, rounded, unequal sided at the base and sessile. The midrib is prominently raised below. There are 2 linear, 3 in. long stipules, united below, and also a pair of reniform appendages about 2 in. long and 1½ in. broad at the base. The scented flowers are in terminal panicles. 2 brown, densely pubescent bracteoles subtend each flower. There are 5 linear sepals, a large standard petal about 5 in. long and broad, clawed and hooded slightly, and 4 petals like the sepals. The sepals and petals are white flushed with red. There are 9 stamens and the unilocular,ovary is velvety brown. The large flat pod is about 2 ft. long and 5 in. broad, velvety brown and with 3 prominent longitudinal ridges. The seeds are about 1¾ in. long and 1¼ in. broad, rectangular, brown and flat.

PHENOLOGY. The tree is evergreen. The new leaves have a red flush and then change to light green before becoming dark green. Flowering takes place from April to aboutthe middle of July. The young pods are evident in August, and are ripe from December to March. Because of their size and colour they are conspicuous as they hang down from the ends of the branches. They dehisce on the tree, curl into a spiral and then drop to the ground.

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SEEDLING. Germination is epigeal. The hypocotyl is up to about 4 in. long, but is ofen shorter; it is brown and fluted. The two large cotyledons do not develop and remain parallel with the hypocotyl and shoot. The first two leaves are opposite and about 4 in. above the cotyledons. Succeeding leaves are alternate. The stipules are green, lanceolate, and about 0.3 in. long. The primary leaf consists of two opposite leaflets, oblong-obovate to oblong-elliptic, often unequal in size, 4-7 in. long, entire, rounded, unequal at the base and sessile.

NATURAL REGENERATION. This is plentiful near the mother trees. The young sedling develops a strong root system which is very necessary for it in the swampy conditions where it grows.

(viii) Macrolobium vignei Hoyle

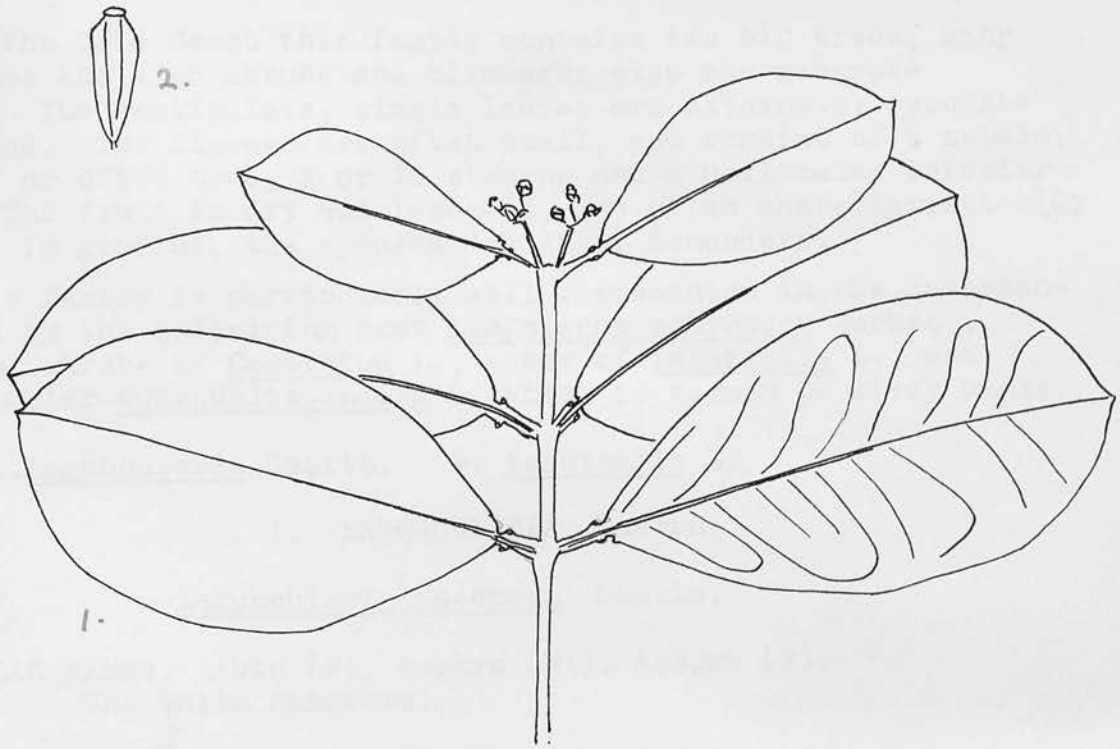
VERNACULAR NAME. Tutuabo (W).

A small tree of about 40-50 ft. high and 4 ft. G.B.H. with

a spreading crown. The wood is brown, hard and fairly heavy. In transverse section the vessels are visible, together with the thick, elliptic parenchyma surrounding them.

BOTANY. The paripinnate leaves consist of 3-4 pairs of opposite leaflets with caducous stipules. The brown pubescence on the rhachis disappears in time. The leaflet is broadly oblong-lanceolate to oblong-elliptic, about 4 in. long and $1\frac{1}{2}$ in. broad, entire, acuminate and mucronate, and almost rounded at the base. The petiolule is short and slightly thickened. The midrib and the fine nerves are raised below. The venation is reticulate. The pod is about 6 in. long and $2\frac{3}{4}$ in. broad, woody, velvety, brownish-black, with small, irregular diagonal ridges. It is chambered inside and has 4 seeds.

DISTRIBUTION. Recorded from Axim and the banks of the Bonsa River. It occurs near Samreboi, where it is locally frequent near watercourses.



Laguncularia racemosa. 1.Branchlet. 2.Fruit. Both x 1.

COMBRETACEAE.

In the Gold Coast this family contains two big trees, many small ones and also shrubs and climbers; also one mangrove species. The exstipulate, simple leaves are alternate, opposite or whorled. The flowers are often small, and consist of 5 sepals, 5 petals or often none, 5 or 10 stamens and a unilocular inferior ovary. The fruit is dry and 1-seeded, and often characteristically winged. In general, the species are light demanders.

This family is particularly well represented in the Savannah-Woodland by the colonising tree Anogeissus schimperi Hochst., trees and shrubs of Combretum L., trees of Terminalia L., and the straggler Quisqualis indica L. which is common on river banks.

GENERA. 1. Laguncularia Gaertn. 2. Terminalia L.

1. LAGUNCULARIA Gaertn.

Laguncularia racemosa Gaertn.

VERNACULAR NAMES. Abin (F). Asokru (Nz). Asopru (F).
The White Mangrove.

This mangrove is very often only about 6 ft. high, but one, measured at the Ankobra River mouth, was 22 ft. high and 9 in. G.B.H. Another at Esiama was 15 ft. high. The tree occurs in saline lagoons and river mouths along the coast. It is gregarious and provides a good firewood.

BOTANY. The leaves are opposite and decussate, obovate, about 2½ in. long and 1½ in. broad, coriaceous, glabrous, entire, rounded and mucronate, very slightly auriculate at the base, and with a winged petiole about 0.3 in. long. The leaf margin is turned over slightly, forming a small ridge, and is gland dotted. There is a pair of marginal glands near the apex of the petiole. The midrib is brown, prominent below but barely visible above, and the nervation is almost indistinct. The inflorescences of small flowers are axillary. The fruit is about ¾ in. long, pointed at one end, elliptical in section and with longitudinal ribs. It is dark brown and pubescent.

PHENOLOGY. The whitish-green flowers occur from February to May, and the fruits are ripe in July to September, but may be found at other times of the year.

2. TERMINALIA L.

SPECIES. (i) T. ivorensis A.Chev. (ii) T. superba Engl.& Diels.

(i) Terminalia ivorensis A.Chev.

VERNACULAR NAMES. Efremeli (S). Emeri (Ash,F,T,W).
Faraeneri (Nz). Frameri (Ao).

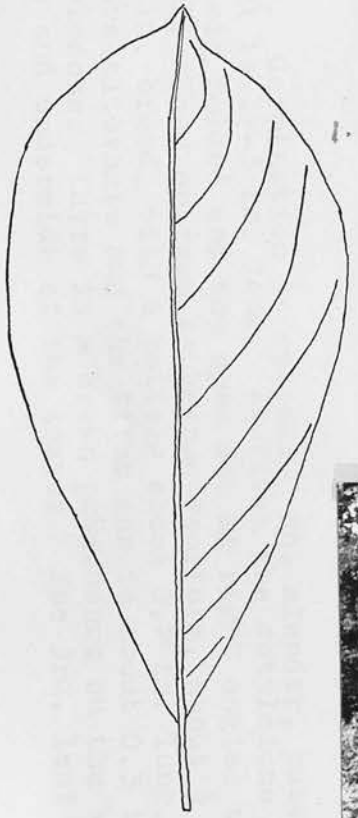
TRADE NAME. Idigbo.

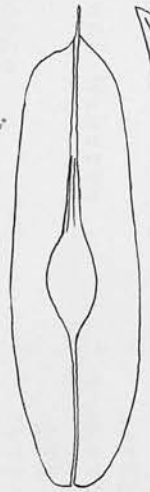
A tall tree of the High Forest. Felled trees from various localities have given the following measurements:

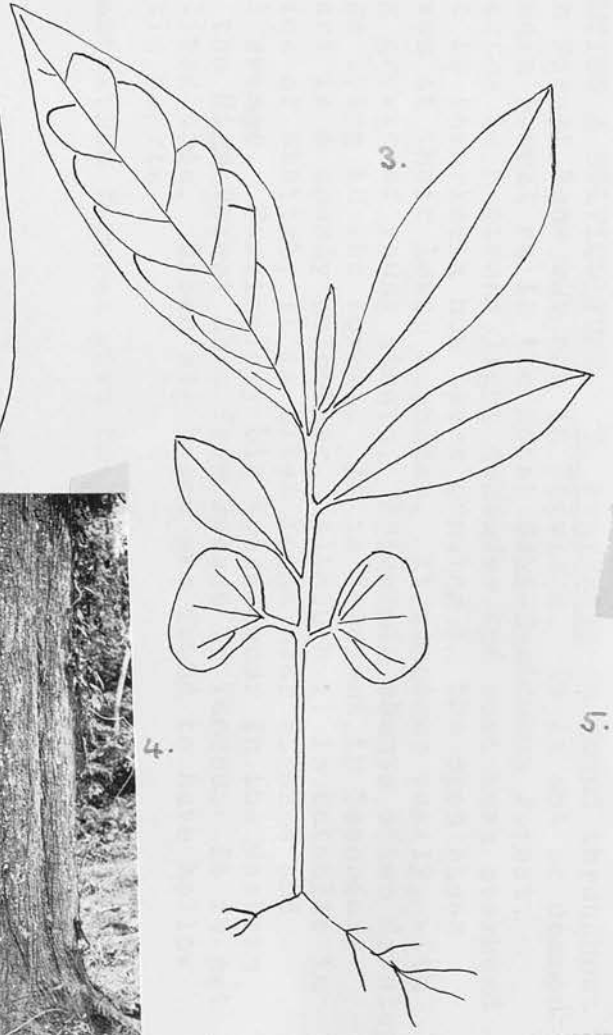
Girth above buttresses		Length of bole		Height of tree	
ft.	in.	ft.	in.	ft.	in.
13	10	76	9	151	8
16	0	71	0	118	0
16	10	90	8	156	8
12	4	61	5	162	10
12	10	62	4	132	7
17	6	82	1	155	11

The tree is usually about 130 ft. high and about 9 ft. girth above buttresses, but is much shorter in open conditions. The bole is straight and clean. There are small buttresses which give rise to fluting of the stem. This fluting may be quite high and so spoil the shape of the bole. Branching is whorled. In the immature tree the branches are at right angles to the stem, but in the crowns of older trees they are inclined upwards. The crown becomes flat topped once the maximum height is reached. The bark looks quite black on the older trees; it is fissured into narrow, longitudinal strips. The slash is dark brown through the outer bark, then a red-brown layer and then bright yellow. The wood is pale yellow, without any distinction between heart and sapwood. It is moderately hard, 35 lb. per cu. ft. seasoned, easy to work and has a slight sheen. Sometimes there is a tendency to splitting while seasoning. When in log form it is liable to pin-hole borers. In transverse section, numerous vessels are just visible and the many fine medullary rays can hardly be seen. The wood is used for roofing shingles, general carpentry, buildings and lorry bodies. It has been used in the U.S.A. for wireless cabinets. In the S.W. of the Gold Coast, where Triplochiton is absent, the tree is used for making dug-out canoes. The bark has been used for coagulating Funtumia rubber latex.

BOTANY. The leaves are crowded spirally at the ends of the branches. The leaf is obovate, about 3 in. long and 1½ in. broad, entire, with a short acuminate apex or acute, cuneate, and with a petiole about ½ in. long. The midrib and nerves are







Terminalia ivorensis. 1.Leaf. 2.Fruit. 3.Seedling.
All x 1. 4.Bole. 5.Tree.

prominent. The petiole and lamina are pubescent but this character disappears in time. The small yellowish flowers are in lax spikes; petals are absent. The fruit is a samara. The wing is oblong, about 2 in. long and 0.6 in. broad. papery, dark brown, emarginate and with a slight stalk. The seed is in the centre and is about 0.4 in. long and 0.2 in. broad.

PHENOLOGY. The tree is deciduous towards the end of February and in March. The flush of new leaves appears in April, and with them come the flowers. Flowering continues until early July. The new fruits are evident soon afterwards and many drop immature. The fruits are not ripe till February, and during this month and March they are shed along with the leaves. Large quantities of fruits are produced annually. They are wind distributed.

DISTRIBUTION & SILVICULTURE. T. ivorensis is found throughout the High Forest Zone but not in Togoland. It is not so common in the Rain Forest as in the Moist Semi-Deciduous Forest. This species is a strong light demander and must have overhead light.It is remarkable how trees growing in the open clean themselves of their lower branches. It coppices easily, with a strong growth of young shoots. Epicormic shoots often develop from logs lying in the forest. It is frequent in Secondary Forest and is a speedy coloniser. Although it is catholic in its choice of habitat, it is often found near streams and seasonal swamps. Particulary big trees occur in the western part of the High Forest Zone from Jabeso to Tanosu. It is not a long lived tree. Often big trees are found to have hollow or brittle hearts.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Subri	965	6	17	15	22	9
Atewa Range	573	22	29	28	15	22
Esukawkaw River	1440	87	35	51	59	99
Oda River	436	24	18	14	15	14
Northern Scarp (West)	577	63	27	9	3	-

SEEDLING. Germination is epigeal. The slender, pubescent hypocotyl is 1½-3 in. long. At first the cotyledons appear convolutely folded and the open out at right angles tothe hypocotyl. They enlarge to become reniform, about ½ in. long and 0.7 in. broad, with a petiole about 0.2 in. long. The primary leaves are alternate and the first one is about 0.3 in. above the cotyledons. There is a brown pubescence on the shoot, petioles and underside of the leaves The 3rd. leaf is oblong-

lanceolate, about 1½ in. long and ½ in. broad, entire, acuminate, cuneate and with a short petiole about 0.1 in. long which is purple sooner or later.

NATURAL REGENERATION. This is abundant. Openings in the forest are readily colonised. The young seedlings appear in June. Where the overhead light is adequate, development is quick and a height of 7 ft. may be attained in the 1st. year. The following measurements were taken from a 4 years old natural sapling in the Bobiri F.R., being representative of the dominants of a pure crop of T. ivorensis which sprang up on an area cleared for, but not used as a nursery:

Length of bole	43 ft.	6 in.
" " crown	14	6
Height " sapling	58	0
Girth breast height	2	11½
" mid bole	2	4

ARTIFICIAL REGENERATION. There are about 180 complete fruits to an ounce and 272 without wings. Germination is poor, but can be raised to about 40% if the seeds are pretreated for a week by alternate soaking and drying - day about. Germination is irregular and averages 32 days. At first growth is slow, but large enough plants are obtainable in 15 months for plantation work. Either stumped or stripped plants may be used. The young plant is very susceptible to drought, and so planting has to be carried out when the soil is moist. Growth is good where conditions are favourable. In Kumasi, a small plantation 8 years old had trees 54 ft. high and 2 ft. 10 in. G.B.H. The stump planted T. ivorensis in the Pra-Anum F.R. 1948 Taungya averaged 18 ft. high and 10 in. G.B.H. at 3 years, and the largest specimens were 24 ft. high and 14 in. G.B.H. The original planting distance was 10 ft. X 10 ft., and the plants had formed closed canopy within 3 years.

A sample tree from the 1939 Taungya in the Pra-Anum F.R. was measured in 1952 and gave the following results:

Length of bole	70 ft.	11 in.
" " crown	29	1
Height " tree	100	0
Girth breast height	3	1
" mid bole	2	9
" under crown	2	2

Because of its rapid growth, this species should not be planted in intimate mixture with others, except T. superba and Triplochiton.

PATHOLOGY. Many seeds are bored by insects as they lie on the ground. Fruits while still on the tree may be galled by an

insect. The gall is about 1 in. diameter, woody and with a small grub in the centre.

(ii) Terminalia superba Engl.& Diels.

SYNONYM. T. altissima A.Chev.

VERNACULAR NAMES. Afraa (S). Faraen (Ao). Kegblale (E). Ofram (Ash,F,T,W).

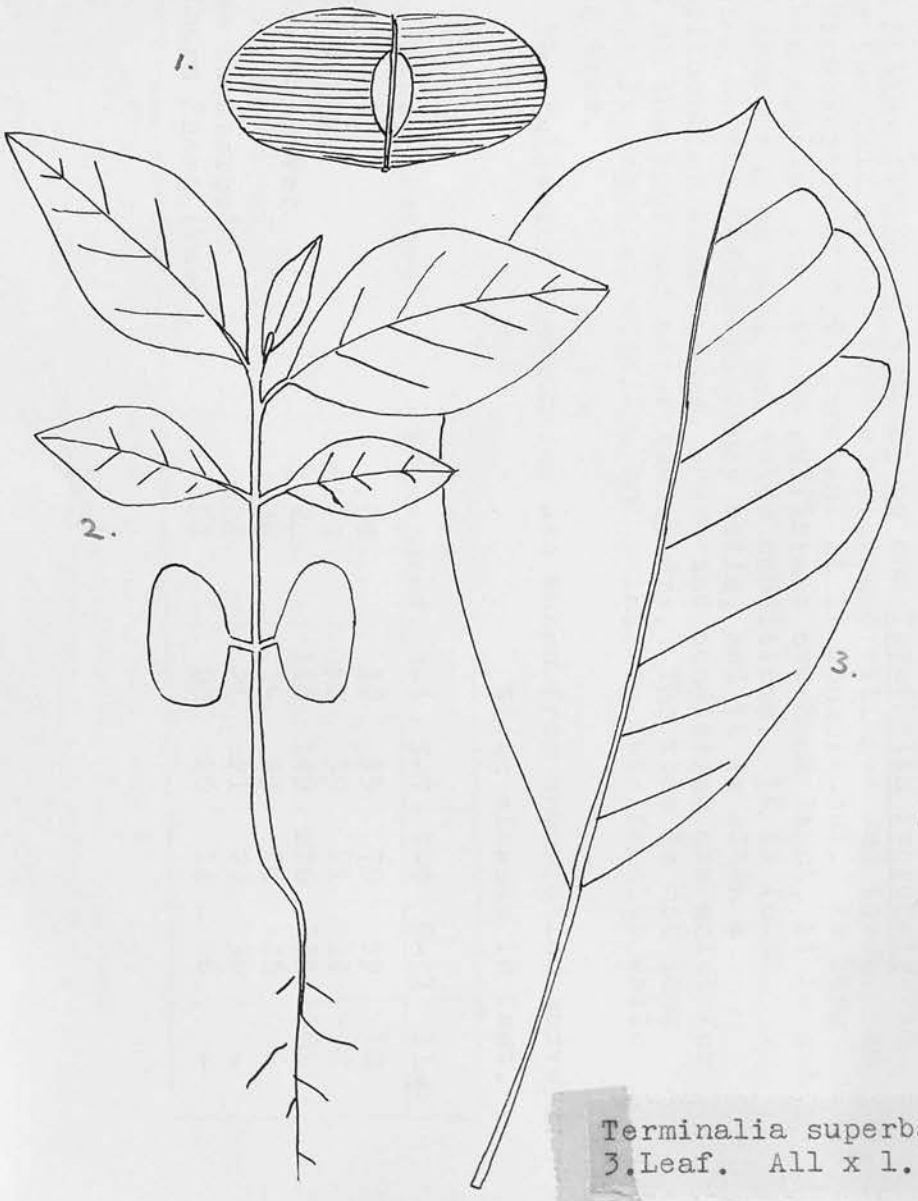
TRADE NAMES. Afara. Limba (Congo).

A tall tree, often 140 ft. high and about 8 ft. girth above buttresses. The following are measurements of felled trees:

Girth above buttresses		Length of bole		Height of tree.	
ft.	in.	ft.	in.	ft.	in.
8	2	85	3	144	4
8	1	78	2	150	3
10	1	88	9	161	5

The stem is very straight, long, slender and cylindrical. The plank buttresses are narrow and high, often reaching 10-15 ft. up the bole. The whorled branches give a many storeyed appearance in the young stages. In the big trees the horizontal branches are relatively short and the crown is semi-circular until old, when it flattens, but not so conspicuously as in T. ivorensis. Epicormic shoots are sometimes developed in those trees which have been damaged by fire in farm clearings, or in very old trees standing in the open. Parrots and hornbills nest in the hollows caused by branches rotting and leaving holes in the stem just under the crown. The foliage is quite dense but the crown is not big. The bark is very attractive because of its pastel colours and the long, broad, regular strips. The slash is fairly thin, with a pinkish tinge in the outer layer and dull yellow-brown below. The wood is light coloured, fairly soft, moderately coarse texture, about 35 lb. per cu. ft. at 15% moisture content, and not durable against fungi and insects. The sapwood is very liable to stain. In transverse section, the scattered vessels can be seen, and also growth rings. The heartwood is often irregularly streaked olive-brown to black-brown. The cause of this discoloration is not known. It produces a very decorative effect which is in demand for furniture and small turnery articles. The wood splits easily and is used for second rate shingles and occasionally for local joinery.

BOTANY. The leaves are simple, obovate, about 4 in. long and 2 in. broad, entire, glabrous, broadly acuminate, cuneate, and with a slender petiole about 2 in. long. The midrib and the nerves are prominent on the undersides. The leaves are grouped towards the ends of the branches. The small yellow-white flowers



Terminalia superba. 1.Fruit. 2.Seedling.
3.Leaf. All x 1. 4.Bole. 5.Tree.

are in lax spikes about 5 in. long. The sepals consist of 5 lobes, the petals are absent and there are 10 stamens and a unilocular inferior ovary. The fruit is a samara, winged laterally, being about $\frac{3}{4}$ in. long and $1\frac{3}{4}$ in. broad. The samara are on a common peduncle.

PHENOLOGY. The tree is deciduous from December until about the middle of February. Flowering coincides with the flushing of the light green leaves. The flowers last for about a month. The abundant fruits are formed early and many fall immature. They are not ripe till December, and are liberated from the tree during its deciduous period. They are wind distributed, and dispersal is effective. It should be noted that some of the smaller trees without fruits shed their old leaves in November and flush soon afterwards.

DISTRIBUTION & SILVICULTURE. T. superba is found throughout the High Forest Zone. It is a strong light demander and readily cleans itself of its lower branches. Growth is vigorous. It has its greatest frequency in Secondary Forest but the largest specimens are those growing in closed High Forest. In the Jabeso-Tanosu area particularly big ones have been seen. It is one of the commonest trees in farmland and along the roads. With Ceiba, Bombax, Triplochiton and Terminalia ivorensis it forms the bulk of the tree crop around villages and towns. In the High Forest of N.E. Togoland it is conspicuous. As long as this species can obtain sufficient overhead light, it is not very demanding on soil and water conditions. It is found growing on the Scarps in sandy soils, and it is often a constituent of semi-swamps, where the conditions are moist for most of the year and never really dry. The tree is not long lived. It coppices readily, and maintains this faculty while a big tree.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Kakum	508	12	55	79	59	18
Upper Wassaw	207	52	59	21	14	2
Esukawkaw River	1440	148	149	226	235	109
Oda River	436	39	63	70	36	6
Amama Shelterbelt	109	26	21	23	36	-
Northern Scarp (West)	577	83	26	14	6	-

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long. At first the cotyledons appear convolutely folded and the open out at right angles to the hypocotyl. They are foliaceous, reniform, about 0.4 in. long and 0.8 in. broad, and the petioles are about 0.15 in. long. The first two primary leaves are about 1 in. above the cotyledons; they are opposite and the remainder are alternate. All are simple, light green and soft in texture. The 3rd. leaf is elliptic, about $1\frac{3}{4}$ in. long and 1 in. broad, entire, with a short, broad acumen or acute, and cuneate at the base. The petiole is slender and about 0.2 in. long. The hypocotyl, shoots, petioles and undersides of the leaves are all light brown tomentose, but the hairs on the underside of the lamina disappear early. The cotyledons are retained for some time.

NATURAL REGENERATION. The quantity of natural seedlings can be described as abundant. In the cotyledon stage they are to be seen in April-May and October-November. It is not known why there is this second germination period, unless it is that some of the seeds dropped in March remain dormant until the second rainy season begins. All are apparently from the one fruiting. Seedlings are to be found almost everywhere, especially in openings in the forest and in clearings such as farms. The young plant is tolerant of light shade at first, but requires full overhead light for proper development. In the Light Density Canopy Plot of the Research Centre in the Afram Headwaters F.R., clumps of T. superba thicket had reached a height of 21 ft. in the 5th. growing season.

The following height measurements are from Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
19 in.	42 in.	60 in.	66 in.
16	19	37	54
20	47	76	123
26	47	72	117
7	25	76	98
13	35	78	130
11	29	53	106

ARTIFICIAL REGENERATION. There are about 230 fruits, complete with wings, to one ounce. Germination is uneven and may take place from 12 to 32 days or longer. The percentage germination is about 65, and the plant percent at 6 months is about 60. The best results are obtained from seed collected from trees during their deciduous period. Either stumped or stripped plants may be used for plantation work, but they will not stand drought at the time of transplanting. The soil must be moist and there should be adequate rainfall until the plants are properly established. Growth is very quick after the first year. A height of 37 ft. was reached in 7 years in the Dunkwa

Plantation in rather swampy ground. The trees in a small plantation in Kumasi averaged 75 ft. high and 3 ft. 7 in. G.B.H. in 14 years. In 1952. a sample tree in the 1939 Taungya in the Pra-Anum F.R. was measured and the results were as follows:

Length of bole	62 ft.	6 in.
" " crown	21	6
Height " tree	84	0
Girth breast height	3	2
" mid bole	2	5
" under crown	1	10

Five years after being stump planted, T. superba poles in the Pra-Anum 1947 Taungya Plantation were 36 ft. high and 2 ft. 3 in. G.B.H.

Where a mixture of species is aimed at in a plantation adjacent to forest, it is almost certain that T. Superba can be obtained by natural regeneration.

PATHOLOGY. The wood is very liable to beetle attack, and it is very necessary to remove the logs from the forest as soon as possible. Both heart and sapwood are susceptible. Powder post beetles (Lyctidae and Bostrychidae), pinhole (Platypodidae and Scolytidae) and longhorns (Cerambycidae) take part in these attacks. The rest of the tree seems to be particulary free of insect and fungal troubles.

FIELD NOTES. T. ivorensis and T. superba are easily confused especially in the seedling, sapling and pole stages, but are readily differentiated when more mature. The following spot characters are given for field identification:

	T. ivorensis	T. superba
Bark - tree	Fissured. Black.	Strips. Pastel colours.
Slash	Yellow	Brownish
Buttresses	Short. Often fluted.	High and narrow.
Fruit	Longer than broad	Broader than long
Leaf	Short petiole	Long petiole
Petiole	Red or purple when young	Yellow.
"	More pubescent	Less pubescent
Seedling 1st. two leaves	Alternate	Opposite .

EBENACEAE.

A family of small trees - sometimes medium sized. The leaves are simple, usually alternate but occasionally opposite, and exstipulate. The flowers are unisexual and the trees monoecious. The fruit is a berry formed from a superior ovary. There are two genera in the Gold Coast - Diospyros L. and Maba L.R.& F.Forst. The flowers are 4- or 5-merous in Diospyros and 3-merous in Maba.

DIOSPYROS L.

Most of the species are trees of the lower storey of the High Forest, but D. mespiliformis Hochst. belongs to the drier conditions of the Savannah-Woodland and the Coastal Scrub and Grassland.

Diospyros sanza-minika A.Chev.

SYNONYM. D. nsambensis Gürke

VERNACULAR NAMES. Esonoakyi (T). Kusibiri (Ash,T). Sanzamouki (Nz). The first name means elephant's back and is a reference to the black, hard bark.

Sometimes known as Flint Bark and Ebony.

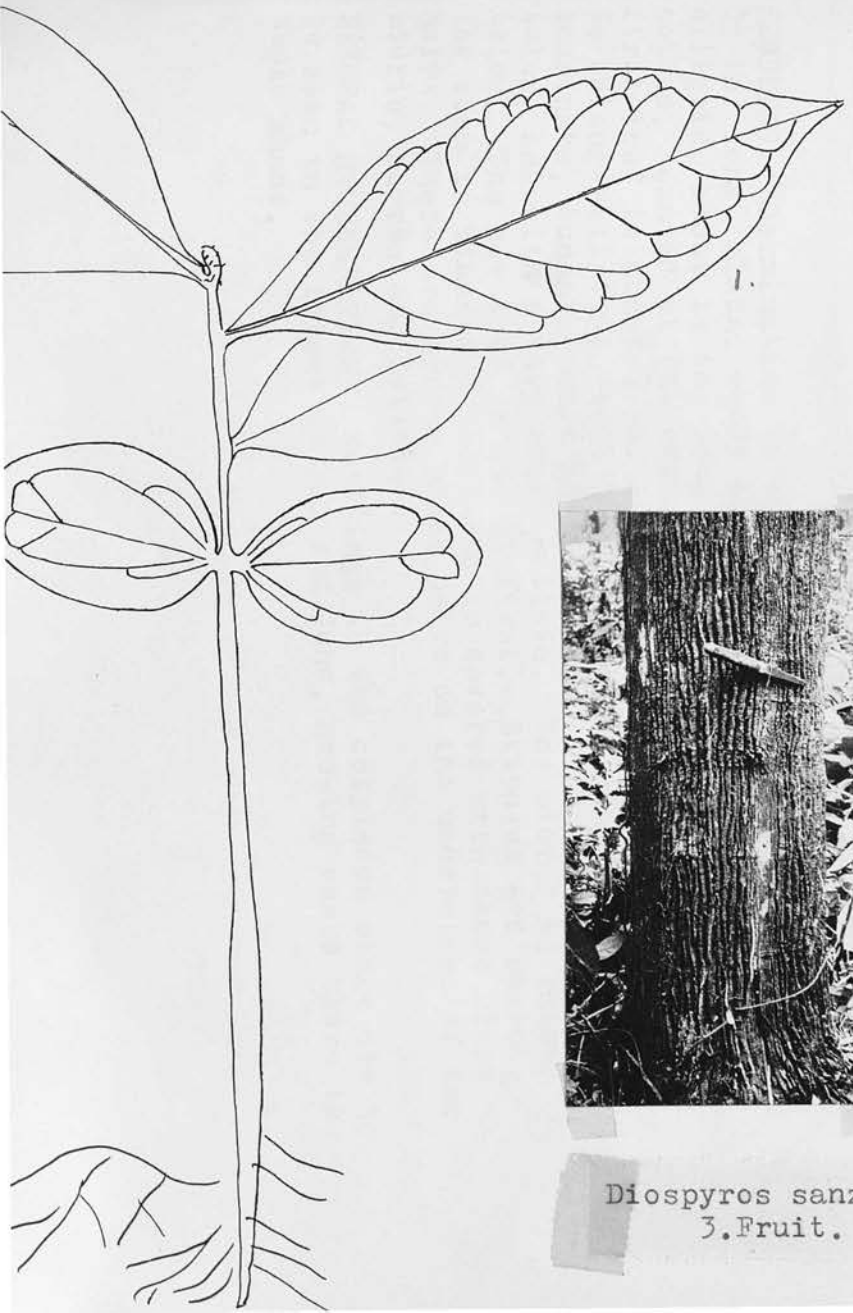
TRADE NAME. African Ebony - but applied to other species too.

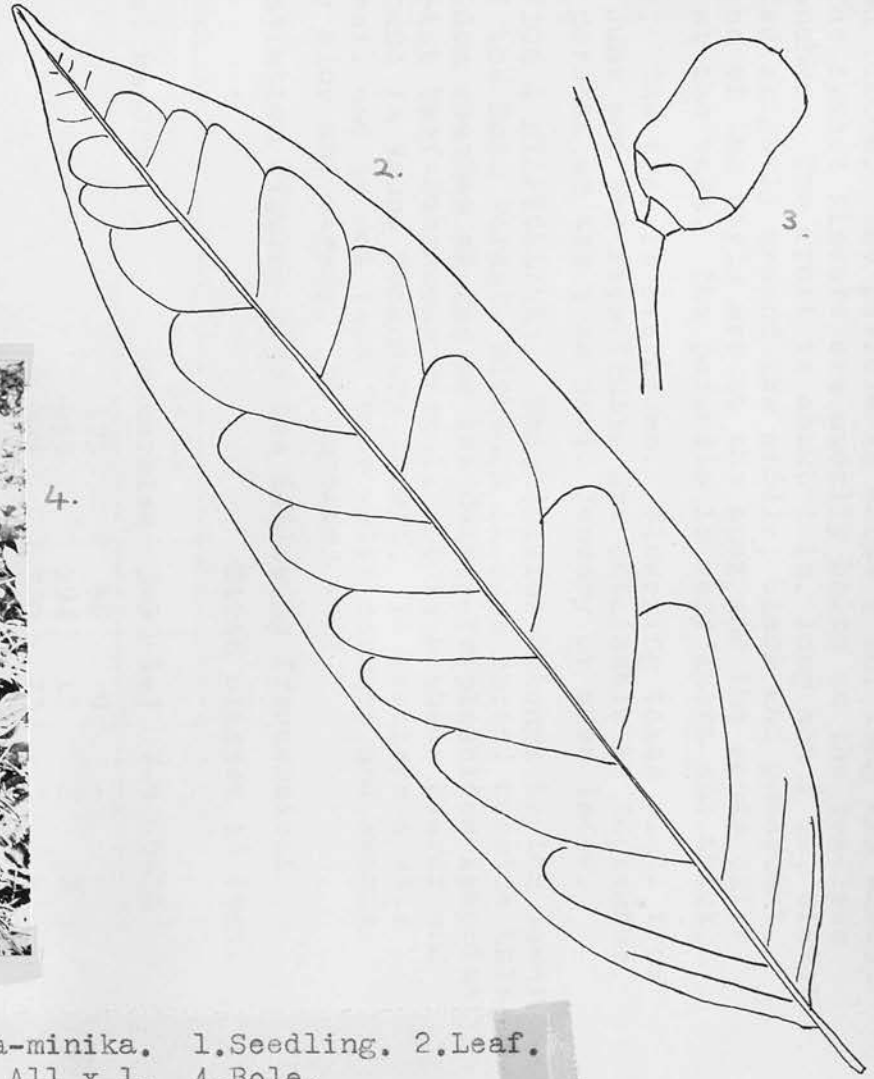
A small to medium sized tree. Two specimens felled in the Subri F.R. gave the following measurements:

Girth breast height	Length of bole	Height of tree.
2 ft. 3 in.	28 ft.	70 ft.
4 4 9	25	63

The bole is straight, cylindrical and slender, and without buttresses. The crown is small. The bark is characteristic; it is black with narrow, long, deep, very hard fissures. The slash shows a jet black outer bark and a light brown inner bark. The sapwood is white and without lustre. The heart is greyish and may be streaked with black. It is hard, heavy (about 60 lb. per cu. ft. air dry), hard to work, with a fine texture and durable. In transverse section, the small vessels can be seen with a hand lens and are loosely grouped radially; the medullary rays are very fine and numerous and the parenchyma is in narrow transverse bands. The wood is used for tool handles.

BOTANY. The leaves are alternate and glabrous. The leaf is oblong-lanceolate to oblong-elliptic, about 7 in. long and 2 in. broad, entire, with a short acuminate apex and broadly cuneate at the base. It is dark green above and glaucous below. The midrib is raised below; the nerves are few in





Diospyros sanza-minika. 1.Seedling. 2.Leaf.
3.Fruit. All x 1. 4.Bole.

number and looped. The petiole is about ½ in. long and almost black. The cymose flowers are usually borne on the leafless older branches. The fruit is about 1 in. long and ¾ in. diameter, constricted slightly around the middle, black and pubescent. The remains of the style are at the apex and the woody calyx persists at the base. The peduncle is very short and thick.

PHENOLOGY. The tree is evergreen. Flowering takes place from April to June and the ripe fruits are obtainable in September; they may persist on the tree until January or even later.

DISTRIBUTION & SILVICULTURE. This species belongs to the lower storey of the Rain Forest, although it does spread outside this zone, seldom reaches as far as the Celtis-Triplochiton Association of the Moist Semi-Deciduous Forest. It is a shade bearer and is not found in young Secondary Forest. It requires a well drained soil and is not found near water courses and swamps. Growth is slow and steady. It coppices well.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11
Ndumfri	175	96	9	-	-
Subri	965	294	12	2	2
Fure	381	220	73	3	-
Pra Suhien I	203	97	10	-	-

SEEDLING. Germination is epigeal. The hypocotyl is about 3½ in. long, black, woody and stout. The cotyledons are elliptic, about 1½ in. long and 1 in. broad, entire, dark green, obtuse, rounded at the base. The phyllotaxis is spiral. The first leaf is about ¾ in. above the cotyledons. The 2nd. leaf is oblong-elliptic, about 3½ in. long and 1½ in. broad, entire, acuminate, cuneate, dark green above and dull lighter green below, and with a very short petiole. The midrib is raised below. The new leaf is red at first. Stipules are absent. The stem is black and woody and is covered with dense black hairs. There are sparse black hairs on the undersides of the midrib, nerves and petioles.

NATURAL REGENERATION. Seedlings in the cotyledon stage are to be seen in the forest in May and June, growing where there is ample shade.

EUPHORBIACEAE.

This family is represented throughout the Gold Coast, largely as small trees and shrubs. Alchornea Sw., Bridelia Willd., Discoglypremna Prain, Macaranga Baill., Phyllanthus L. and Ricinodendron Mull. Arg. are common in Secondary Forest. Bridelia Fluggea Willd. and Hymenocardia Wall. are found in the Savannah-Woodland. Spondianthus Engl. and some species of Uapaca Baill. are associated with wet areas in the High Forest. Cleidon Bl., Mareya Baill. and Microdesmis Planch. are very common understorey trees of the Moist Semi-Deciduous Forest. Elaeophorbia Stapf is a prominent feature ofthe Accra Plains. The introduced Manihot esculenta Crantz -cassava- is a most important staple food, and Hevea braziliensis Müll. Arg. is grown in a few plantations for Para rubber.

This large family shows varying morphological characters. The leaves may be simple or digitate, usually stipulate and alternate, and may be gland dotted and have stellate hairs. Some genera have a milky latex. The flowers are unisexual, usually monoecious and often small. Sepals may be present or absent; petals are more often absent; the stamens vary from one to many; the superior ovary is typically 3-celled, but there are exceptions. The fruit is a capsule or a drupe.

GENERA. 1. Discoglypremna Prain 2. Ricinodendron Müll. Arg. 3. Uapaca Baill.

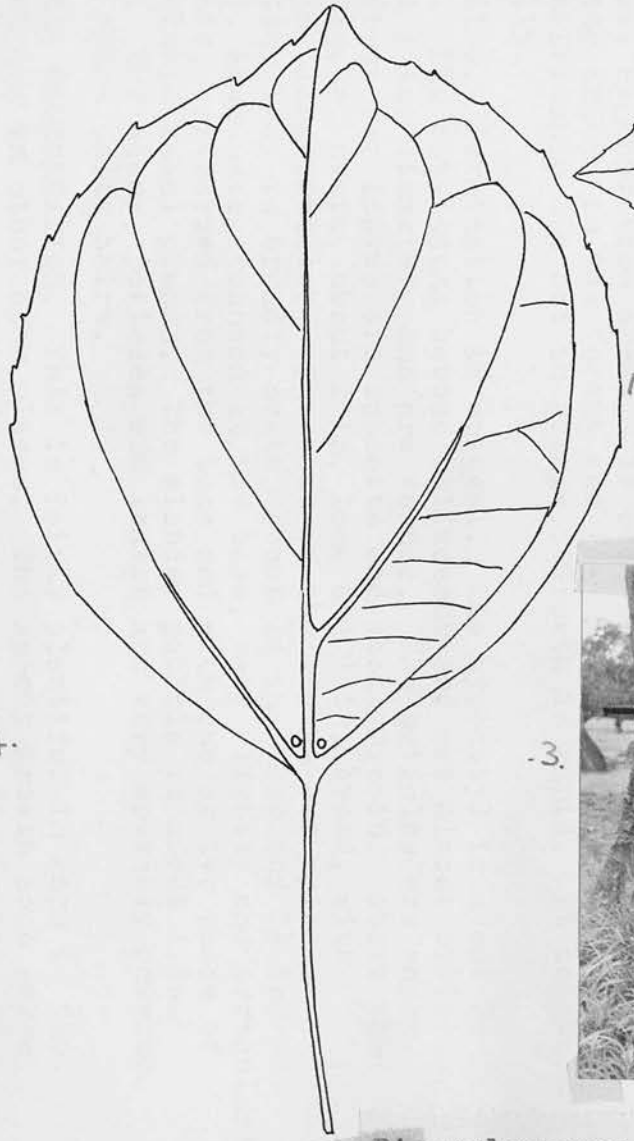
1. DISCOGLYPREMNA Prain

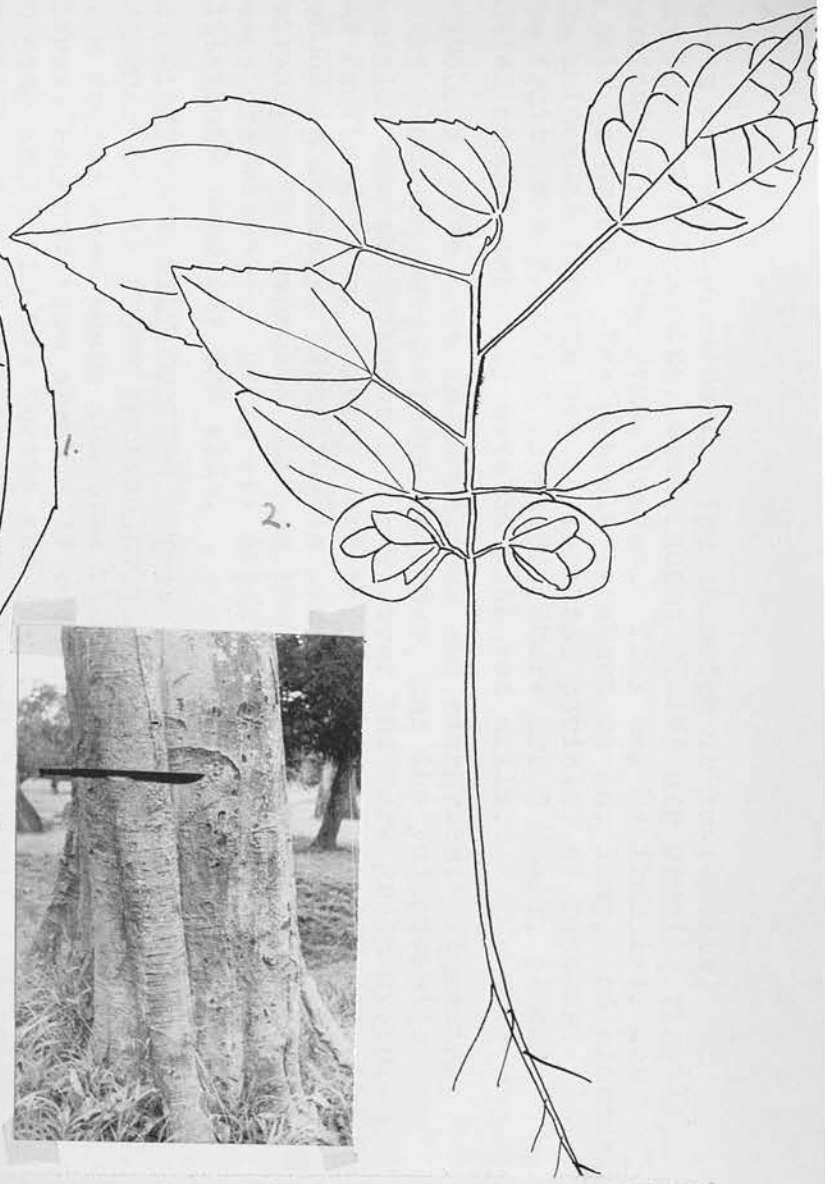
Discoglypremna caloneura Prain

VERNACULAR NAMES. Nnomanamegyama (Ash). Nnomanamedua (T).

A small to medium sized tree of about 80 ft. high, which may attain a girth of 10 ft., but more often is about 35 ft. high and 4 ft. G.B.H. The bole is slightly fluted at the base. The crown of thin branches is small. The bark is light grey, fairly smooth. The slash is light yellow-brown and granular, and the sapwood yellow. The white to yellowish heart is moderately light and soft. It is not durable and stains readily. In transverse section the small and scattered vessels can be seen. The extremely fine medullary rays are visible with a hand lens.

BOTANY. The leaves are arranged spirally. The leaf is simple, sub-orbicular to broadly elliptic, up to about 5½ in. long and 3½ in. broad, broadly cuneate or sometimes rounded at the base, dull, dark green above and dull, light green below. The margin has widely spaced serrations which tend to disappear in the leaves of mature trees. The leaf is 3-nerved from the base. The midrib and nerves are raised below, and the secondary





Discoglypremna caloneura. 1.Leaf. 2.Seedling.
Both x 1. 3.Bole. 4.Tree.

nerves are also prominent. The venation is reticulate. At the base of the lamina, translucent glands are usually visible, particularly in the young leaves. They may be from 1-4, but a pair is normal. The petiole is about 2½ in. long, and slender. The unisexual flowers are in terminal panicles of racemes. The fruit is a 3-celled capsule. There are 3 small, black, pitted seeds, entirely covered with red arils.

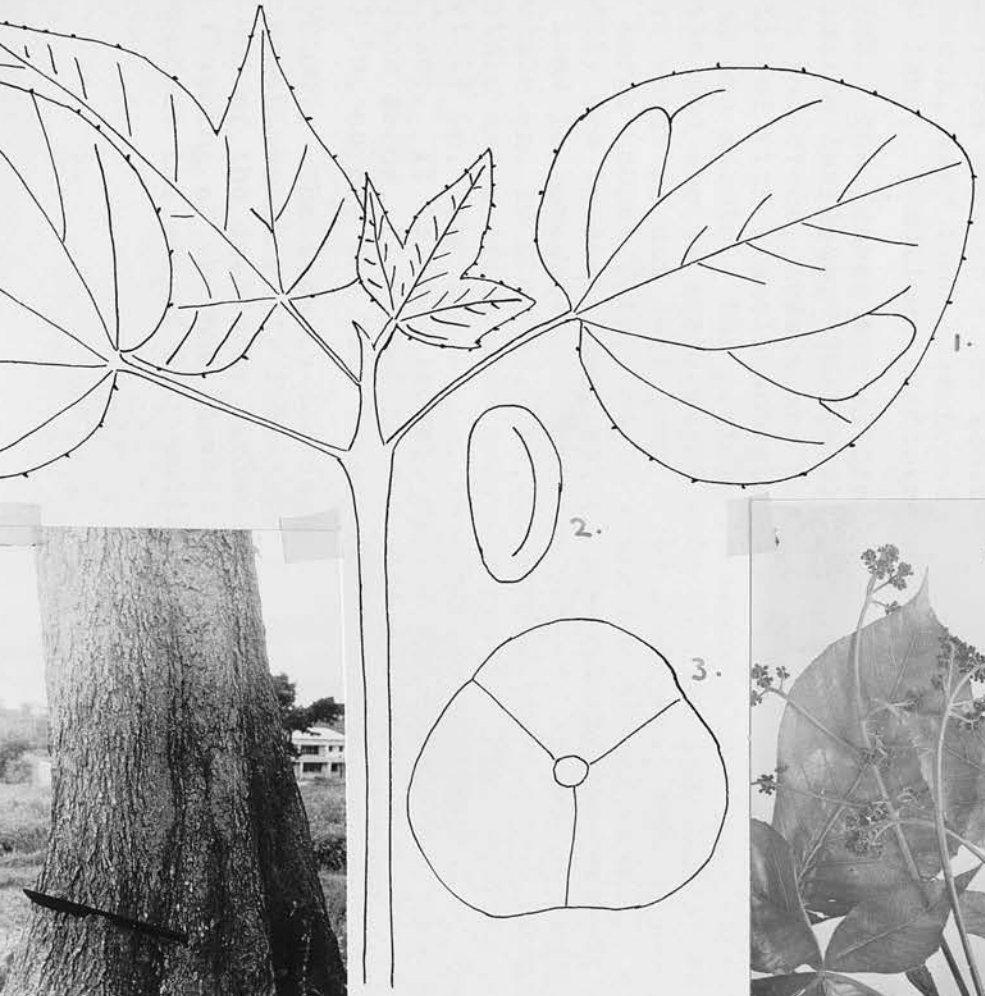
PHENOLOGY. The tree is monoecious and evergreen. Flowering takes place in November and December, and the yellow-white panicles are conspicuous as they cover the dark green crown. The fruits develop quickly, and the seeds begin to drop to the ground in January. Fruiting is usually over by the end of February. The capsules open on the tree and the red arillate seeds are visible. Birds are attacted by the seeds and distribute them far and wide.

DISTRIBUTION & SILVICULTURE. This species is a strong light demander and is found particularly in Secondary Forest. It is a common weed where the tree canopy has been opened in Natural Regeneration areas. It occupies such open spaces as logging tracks in the forest and farms, but is usually found as individuals and not in groups. Growth is rapid. It coppices readily.

SEEDLING. Germination is epigeal. The hypocotyl is about 2½ in. long. The cotyledons become foliaceous and are almost orbicular, about ½ in. diameter, and are veined. The petioles are short. The first two leaves are opposite and about 0.6 in. above the cotyledons, ovate, about 1 in. long and ½ in. broad, with 0.4 in. long petioles. The rest of the leaves are spiral. The 4th. leaf is broadly ovate, about 1½ in. long and 1¼ in. broad, acuminate, rounded at the base, very slightly and irregularly serrate, tri-nerved from the base and with one or two pairs of translucid basal glands. The slender petiole is about 1 in. long. The stems, petioles and leaves are very sparsely covered with short white hairs.

NATURAL REGENERATION. This is fairly plentiful in gaps in the forest and in other open places. The speedy growth soon makes the plant prominent. It may grow as much as 4 ft. in its first year, if there is sufficient overhead light. Seedlings soon die if in low shade.

ARTIFICIAL REGENERATION. There are about 390 seeds to an ounce. The germination period is 21 days and the percentage germination about 85.



4.

5.

Ricinodendrom africanum.
1.Seedling. 2.Seed.
3.Fruit. All x 1.
4.Flowering branchlet.
5.Tree. 6.Bole.

2. RICINODENDRON Müll. Arg.

Ricinodendron africanum Mull. Arg.

VERNACULAR NAMES. Asoma (Nz,W). Engwanle (Nz). Epi (Ash). Epui (Ao). Ewan (S). Wama (Ash,F,T,W). Asoma is also applied to Parkia bicolor A.Chev.)

TRADE NAME. Erimado.

In the High Forest, this tree may reach a height of 100 ft. but it is usually seen as a smaller tree. Often it reaches a large girth and 10 ft. G.B.H. is not unusual. Frequently the bole is short and is often very twisted and fluted to the crown; the buttresses may be quite big. The crown is low, spreading, rounded, and frequently is reminiscent of a candelabrum. The fairly stout branches are whorled and rise sharply. They are liable to break off suddenly. The bark is dark grey-brown, scaly and shaggy looking. The thick, pinkish-brown slash has white vertical lines in it. The white, soft sapwood has fairly large vessels. The heart is a light brownish colour, soft, light, not durable and liable to stain. It is about 22 lb. per cu. ft., air dry, coarse but straight grained. In transverse section a few scattered vessels are visible. The numerous, very fine, close medullary rays can be seen with a hand lens. Sometimes platters are cut out of the wood.

BOTANY. The leaves are alternate and digitate, usually with 5 sessile leaflets. The leaflet is obovate, about 8 in. long and 4 in. broad, acuminate, cuneate and entire. The lamina is dotted with translucent glands and black ones are prominent along the margin. The petiole is about 9 in. long. The young leaves and shoots are covered with a white tomentum of stellate hairs which do not last long. The deciduous, foliaceous stipules are large (about $\frac{3}{4}$ in. long), green and deeply toothed, and are usually one to each leaf, set to one side of the petiole base. The tree is monoecious. The male flowers contain 5 sepals, 5 petals and 10 stamens. In the female there are 5 sepals, 5 petals and a trilocular superior ovary. The fruit is 3-lobed, about $1\frac{1}{4}$ in. long and $1\frac{3}{4}$ in. in diameter, flattened at the apex and base. It is indehiscent, yellow and fleshy and contains 3 black seeds, flattened on one side and about 0.9 in. long and 0.75 in. across the flat face.

PHENOLOGY. The tree is deciduous in December and January, and sometimes in early February. Flowering takes place at the end of the deciduous period but is usually coincident with the flushing of the new leaves. The mature fruits are available from about the end of July until the middle of October. They

are evident because of their smell which resembles over-ripe apples. They are produced in large quantities. Most of them remain dormant for about 6 months. Thompson (43) says that the fruit is distributed by bats. It is also dispersed by hornbills and by rodents.

DISTRIBUTION & SILVICULTURE. This tree is found throughout the High Forest Zone and in the Riverain Forest of the southern Savannah-Woodland. It is less common in the Rain Forest than in the Moist Semi-Deciduous Forest. This species is essentially a light demander and its greatest frequency is in Secondary Forest. It is not a long lived tree; dead standing specimens are not uncommon.

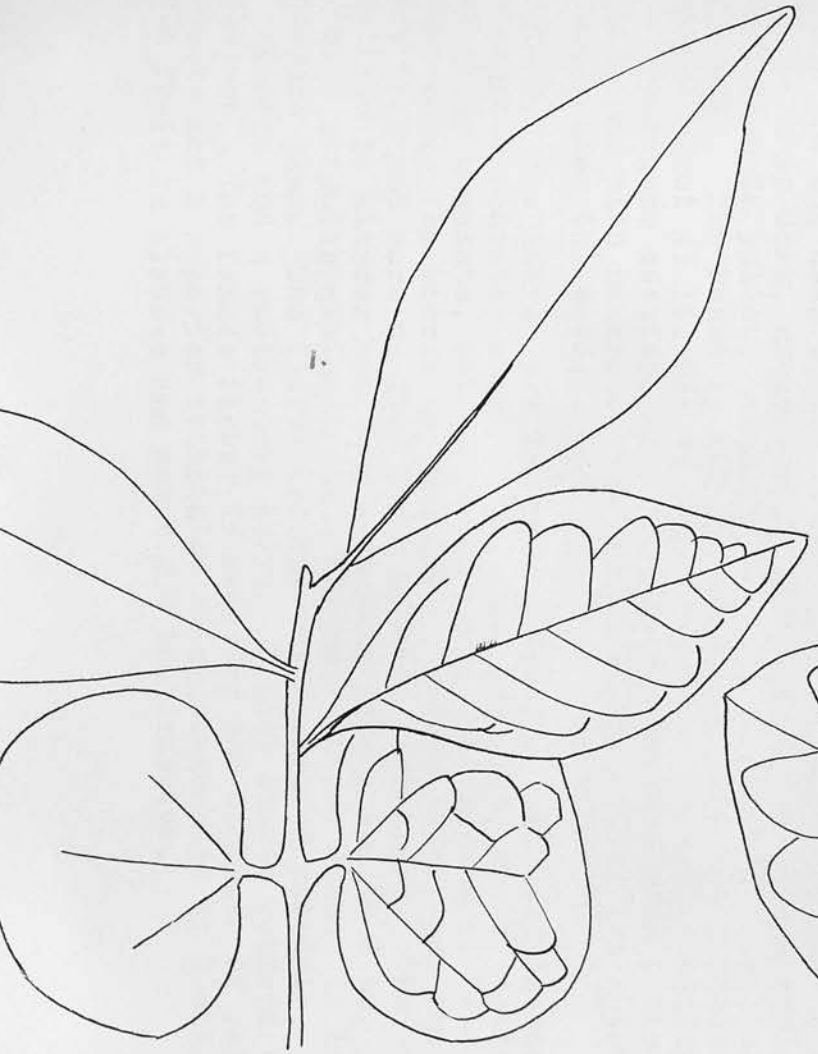
Enumeration surveys give the following frequencies:

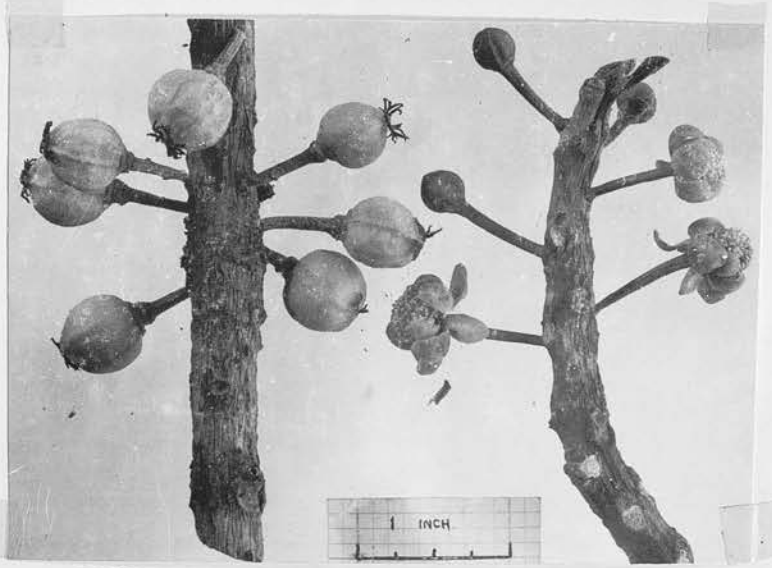
Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Upper Wassaw	207	101	58	24	9	9
Asenanyo	77	18	11	11	3	3
Bia Tano	263	42	45	34	5	1
Aparapi Shelterbelt	47	26	8	8	2	1
Bonkoni	167	10	19	21	15	-

SEEDLING. Germination is epigeal. The hypocotyl is about $3\frac{1}{2}$ in. long and stout. Fibrous toots and not a tap root are formed. The cotyledons become foliaceous and are broadly cordate, about $2\frac{1}{2}$ in. long and broad, entire and veined. The slender petioles are about $1\frac{1}{4}$ in. long The leaves are alternate and the first ones are simple, palmate, about $2\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad, with a slender petiole about $\frac{3}{4}$ in. long. The leaves and stem are covered with a dense mass of white stellate hairs, and the margins of the cotyledons and leaves bear conspicuous black glandular dots.

NATURAL REGENERATION. Ricinodendron is one of the commonest seedlings seen in the more open parts of the forest, such as along timber extraction routesand in areas opened up for Natural Regeneration works. It is abundant in new farm clearings. Often the seedlings are grouped in threes - the product of an entire fruit. The seedlings appear in abundance in March-April, from 6 month old fruits. They progress rapidly where they have plenty of overhead light. A natural sapling growing in a taungya plantation in the Pra-Anum F.R. was 32 ft. high when 4 years old.

ARTIFICIAL REGENERATION. There are about 17 seeds to an ounce. The germination period averages 12 days, and about 78% germinate.





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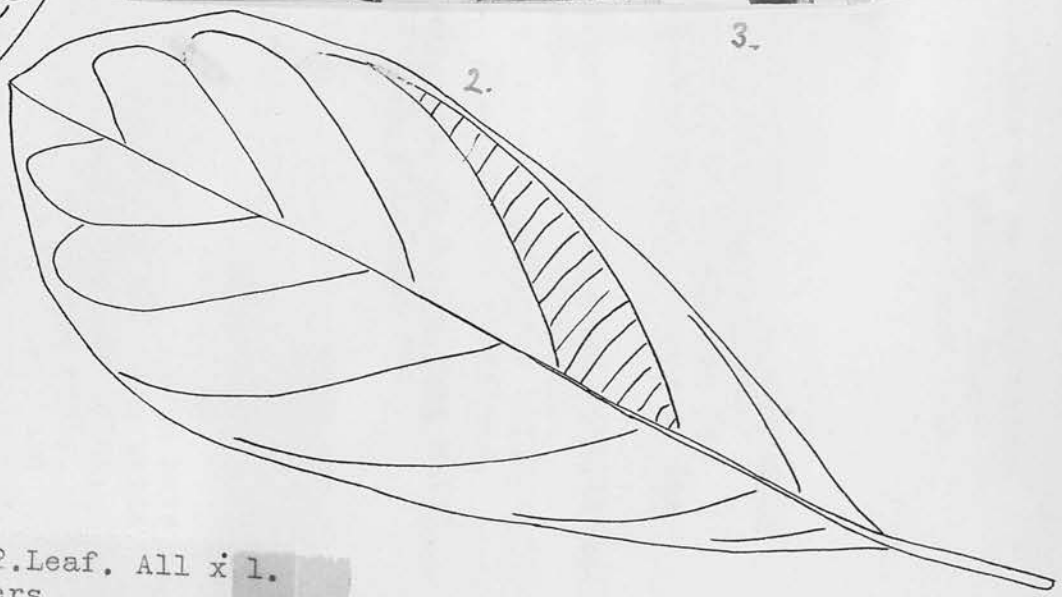


Uapaca guineense. 1.Seedling. 2.Leaf. All x 1.
3.Fruits & male flowers.

PATHOLOGY. The seedlings are susceptible to an aphid which causes the leaves to curl, and may kill the plant. These attacks are only apparent on seedlings in their first year.

3. UAPACA Baill.

This genus of small trees is represented by 6 species in the Gold Coast. Of these, not much is known of U. esculenta A.Chev. ex Aubrév.& Léan. and said (?) to be an intimate associate of U. guineensis, and similar to it but for its larger fruits, and also U. somon Aubrév.& Léan., a tree of the Savannah-Woodland.

In habitat, the species vary from the dry exposed conditions of the Savannah-Woodland to the swamps of the Rain Forest. Three of the species described below develop prominent stilt roots which may be as high as 9 ft. The genus is dioecious.

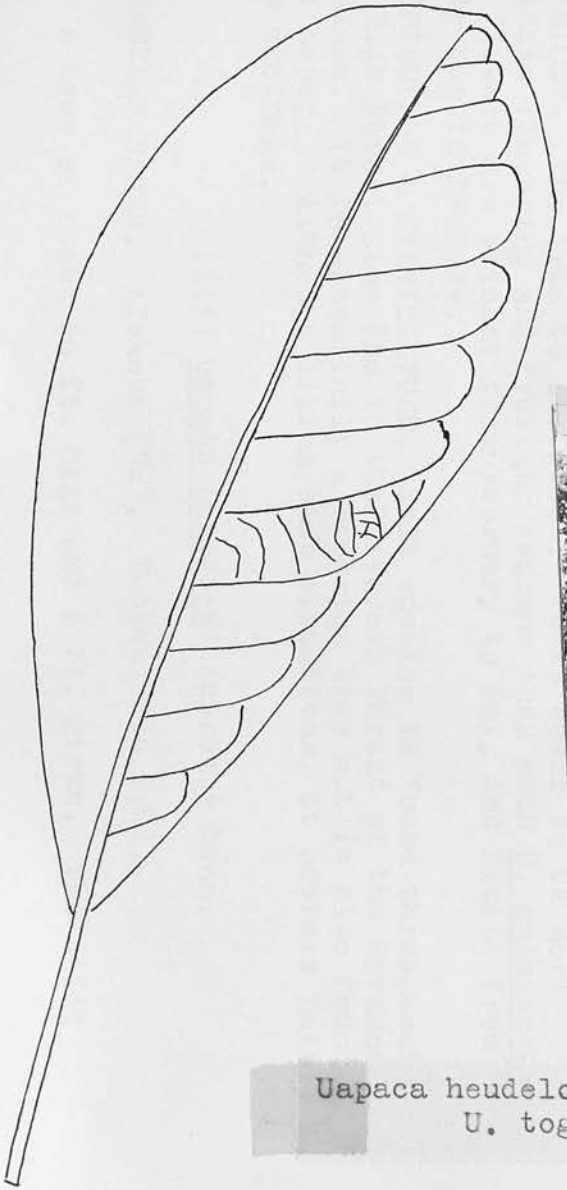
SPECIES. (i) U. guineensis Müll. Arg. (ii) U. heudelotii Baill. (iii) U. paludosa Aubrév.& Léan. (iv) U. togoensis Pax.

(i) Uapaca guineensis Müll. Arg.

VERNACULAR NAMES. Alokoba (Nz). Kuntan (Ash,T,W).

A tree of about 60 ft. high and not often surpassing about 5 ft. girth, although specimens of about 7 ft. girth have been seen. The bole is not very long because of the high stilt roots and the deep crown. The latter is dense and spreading. The bark is dark, green-brown, smooth, but may become scaly. The slash is yellow, darkening rapidly to pinkish brown, and granular. The heart is red to red-brown, hard and durable and weighs about 47 lb. per cu. ft. seasoned. It splits easily. In transverse section, many vessels can be seen with a hand lens, and also numerous fine medullary rays which are slightly redder than the wood.

BOTANY. The leaves are arranged spirally. The leaf is simple, elongated obovate, about 4½ in. long and 2 in. broad, entire, slightly undulate, obtuse at the apex, with a cuneate base and glabrous. The midrib and nerves are raised below, and the veins are fine and more or less parallel with each other. The petiole is slender and long - varying from 1 in. to 2 in. The linear stipules are caducous. The male inflorescence is in a globose head. The flower consists of a reduced perianth, 5 stamens and a rudimentary ovary. Yellow bracts subtend the flowers. The female flower is solitary and consists of yellow bracts and a superior trilocular ovary surmounted by 3 stigmata. The fruit is globose and about 0.8 in. diameter.



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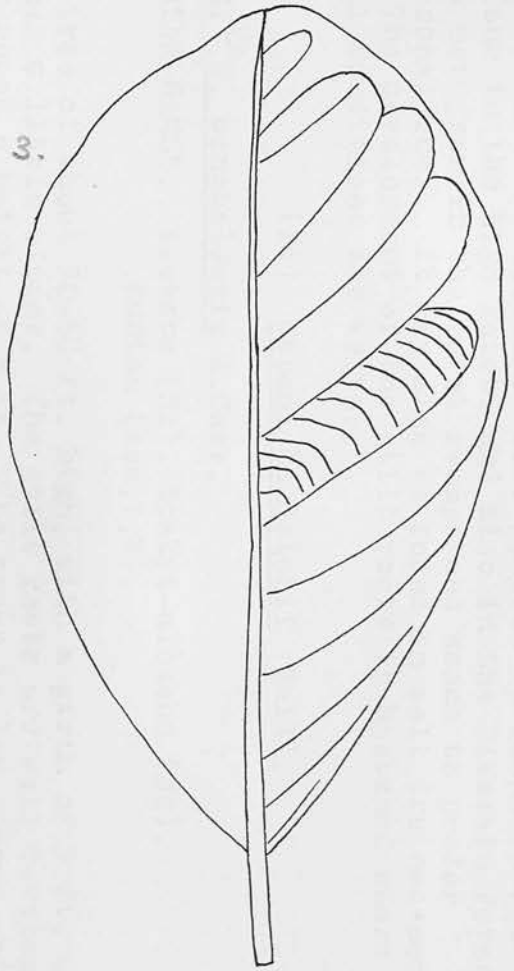


3.

Uapaca heudelotii. 1.Leaf x 1. 2.Stilt roots.
U. togoensis. 3.Leaf x 1.

PHENOLOGY. The tree is evergreen. Flowering and fruiting appear to have no regular periods and occur almost throughout the year.

DISTRIBUTION & SILVICULTURE. This species is found in wet situations in the High Forest and also in the Riverain Forest. It does not grow in the worst swamps and seems to prefer the seasonal ones. It may also be found in well drained moist soil. The development of the stilt roots is hastened where the soil conditions are wetter.

(ii) Uapaca heudelotii Baill.

SYNONYM. U. benguelensis A.Chev.

VERNACULAR NAMES. Alokoba (Nz). Kpakyi-alokoba (Nz). Kuntan (Ash,T,W).

A tree of about 50-60 ft. high, with a girth of 5 ft. or sometimes a little bigger. The stilt roots are well developed and may reach a height of 8 ft. The crown is low, dense and spreading. The slash is reddish, and the heart is red-brown, hard, durable and splits well. It makes a good firewood and is also used for building poles in North Ashanti.

BOTANY. The leaf is glabrous, oblong-oblanceolate, about 5 in. long and 2 in. broad, or larger, entire, obtuse or almost rounded at the apex, cuneate at the base and with a slender petiole 1-2 in. long. The midrib and nerves are raised below, and the veins are not so conspicuously parallel as in U. guineensis. The stipules are small, linear and caducous. The flowers are similar to those of U. guineensis, except that the bracts are greenish and the calyx of the male flower is glabrous. The fruit is ellipsoid, about 1½ in. long and 1 in. diameter.

PHENOLOGY. The tree is evergreen. There seems to be more definite flowering and fruiting seasons than with U. guineensis. The flowers are evident from February to May, and fruits from September to December.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone and in the Riverain Forest of the Savannah-Woodland. It is essentially a riparian tree but is also found near swamps. Although liking damp situations, it prefers fairly free drainage.

(iii) Uapaca paludosa Aubrév.& Léan.

VERNACULAR NAMES. Alokoba (Nz). Kuntan (Ash,T,W).

A tree of about 60 ft. high and 6 ft. girth. The stilt

roots are well developed and reach a height of about 10 ft. The crown is dense, low and spreading. The bark is greenish-grey and slightly rough. The slash is soft, dull reddish-brown, and the sapwood is pinkish-white. In transverse section the vessels and the medullary rays are just visible. The vessels appear very shiny in longitudinal section as if they contained a lot of gum.

BOTANY. The leaves are alternate, very large and crowded towards the ends of the branchlets. The leaf is ovate, up to about 21 in. long and 11 in. broad, with a slightly undulate margin, rounded at the apex or with a short, broad acumen, broadly cuneate or almost rounded at the base, and with a stout petiole about 3 in. long. The midrib is slightly raised above, but prominently raised below, as are also the nerves. The veins are almost parallel with each other. A rusty brown pubescence covers the underside of the lamina, the midrib above, the petiole and the branchlets. The stipule is foliaceous, ovate, about 1½ in. long and ¾ in. broad, acuminate and pubescent. The male inflorescence is about ½ in. diameter and conspicuous with its yellow bracts.

PHENOLOGY. The tree is evergreen. Flowers have been collected from September to January, and fruits from May to September.

DISTRIBUTION & SILVICULTURE. U. paludosa belongs to the freshwater swamps of the Rain Forest. It may extend into the Moist Semi-Deciduous Forest, but there are no confirmed reports of it occurring there. It grows successfully in a heavy, permanently wet soil.

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, green and fairly stout. The cotyledons are reniform and large, about 1¼ in. long and 2 in. broad, with petioles about 0.2 in. long, fairly broad and flattened; they are dark green above and light green below. The stem is green and the phyllotaxis is spiral. The 1st. leaf is about ¾ in. above the cotyledons. It is elliptic to obovate, about 3½ in. long and 1¾ in. broad, entire, obtuse, cuneate, dark green above and light green below. The petiole is stout, about 0.3 in. long and somewhat curved. The paired stipules are small and often only one develops. The young leaf is bronze in colour at first.

NATURAL REGENERATION. In the Subri F.R., abundant regeneration in the cotyledonous stage has been observed under mother trees in July.

(iv) Uapaca togoensis Pax

A tree of about 30 ft. high, without stilt roots. The crown is dense, low and rounded. The bark is fairly smooth and

the slash is red and somewhat granular. The wood is reddish-brown, moderately hard and heavy. With a hand lens the numerous vessels can be seen, and also the medullary rays which are slightly redder than the wood.

BOTANY. The leaf is simple, obovate-elliptic, about 4½ in. long and 2½ in. broad, entire or with a slightly undulate margin, rounded at the apex and broadly cuneate. The midrib and nerves are prominently raised below, and the underside of the lamina is conspicuously pubescent. The petiole is fairly stout and about ½ in. long. The stipules are caducous. The bracts are yellow and the fruit is more or less globose, about 1 in. diameter and warted.

PHENOLOGY. Flowers have been recorded from September to November and fruits in May.

DISTRIBUTION. This species is found in the Togoland hills and the Derived Savannah-Woodland, as at Ejura.

FLACOURTIACEAE.

A family of shrubs and small trees, and also two Gold Coast genera of tall trees. The leaves are often simple, alternate, coriaceous, and with caducous stipules. The flowers are hermaphrodite or polygamous, and the floral parts are variable, but the superior ovary is unilocular. Some genera are armed with spines.

Among the more common small trees are Caloncoba Gilg and Oncoba Forsk. Ophiobotrys zenkeri Gilg is a tall, slender tree of the Moist Semi-Deciduous Forest.

SCOTTELLIA Oliv.

The two species in the Gold Coast are not separated by the natives, who apply the same names to both. Indeed, it is not easy to distinguish the one from the other.

SPECIES. (i) S. chevalieri Chipp (ii) S. coriacea A.Chev.

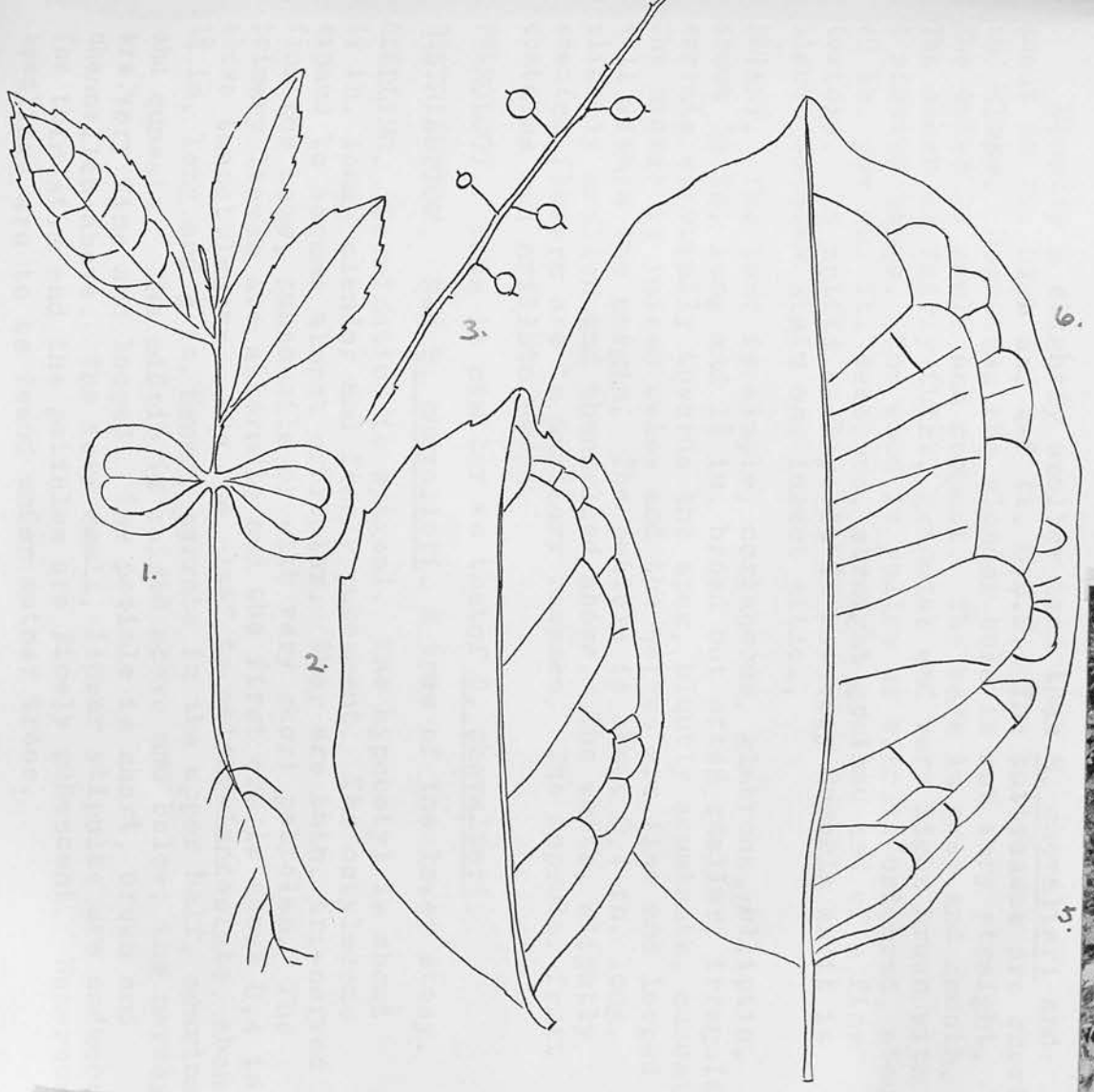
(i) Scottellia chevalieri Chipp

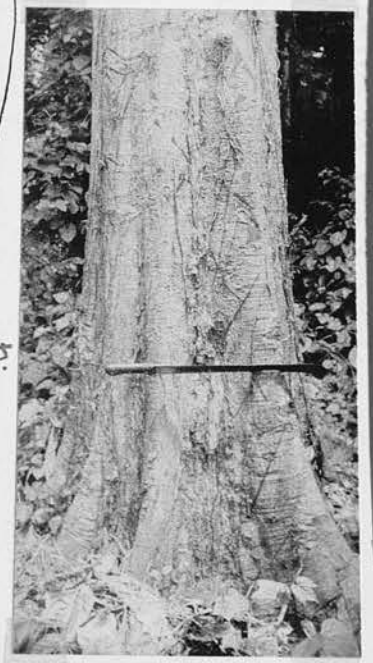
SYNONYM. S. kamerunensis A.Chev.

VERNACULAR NAMES. Dein (S). Kruku (W). Tiabutuo (Ash). This last name is also applied to Sacoglottis Mart.

A fairly tall, slender tree reaching up to 100-120 ft. high and with a girth of 4-6 ft. Sometimes a larger specimen is seen. The bole is clear, with small narrow buttresses, and the crown is small and compact. The bark is light grey, often smooth, but in old trees the round scales flake off leaving a hammered appearance. The slash is light brown, granular, and darkens quickly on exposure. The sapwood is whitish, and the heart yellow-white. It is moderately hard and heavy, and splits easily, and is sometimes used in building native houses. In transverse section, the medullary rays are numerous, conspicuous and very close, and in radial section they show up as a "silver grain".

BOTANY. The leaves are alternate, simple, glabrous, coriaceous, dark green, and the small, linear stipules are caducous. The leaf is elliptic, 3-5 in. long and 2-4 in. wide, with an undulate or slightly serrate margin, bluntly acuminate, and more or less rounded at the base. The midrib is prominent below and the nerves are looped well within the margin. The petiole is $\frac{1}{2}$-$\frac{3}{4}$ in. long and channelled above. The small white flowers are in axillary racemes. The complete flower consists of 5 sepals, petals and stamens, and a superior, unilocular ovary





Scottellia coriacea. 1.Seedling. 2.Leaf. 3.Fruits.
All x 1. 4.Tree. 5.Bole. S. chevalieri. 6.Leaf x 1.

surmounted by 3 styles. On the upper side of each petal is a hairy appendage. The small fruit is a capsule containing red arillate seeds.

PHENOLOGY. Flowering takes place from April to August. The fruits ripen quickly and may be collected from August to October, or even earlier. Young trees flower freely.

DISTRIBUTION. Owing to the confusion in the identity of the two species, their individual distributions are not properly known. It is possible that S. chevalieri is more common in the northern part of the High Forest Zone, and S. coriacea in the southern part. S. chevalieri is seldom a big tree and is not among the dominants.

(ii) Scottellia coriacea A.Chev.

VERNACULAR NAMES. As for S. chevalieri.

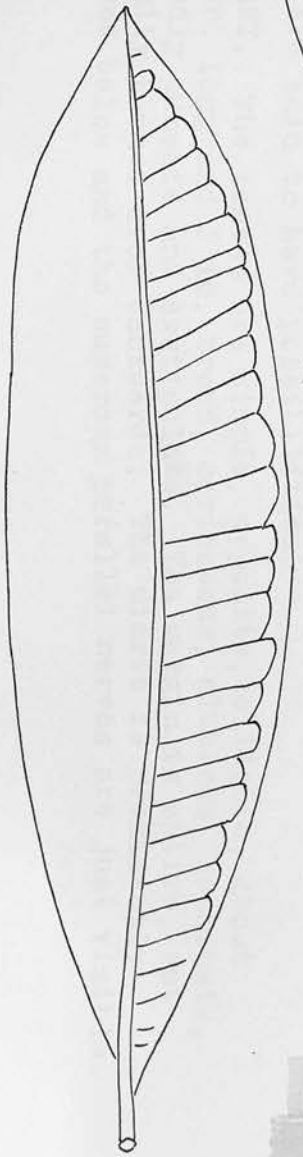
Usually a slightly smaller tree than S. chevalieri and about 60 ft. high and 4-5 ft. G.B.H. The buttresses are short and close. Sometimes the slender bole is not very straight. The crown is small and compact. The bark is grey and smooth. The slash is fairly thick, granular and very light brown with a pinkish tinge. The wood is yellow or biscuit coloured, about 40 lb. per cu. ft. seasoned, straight grained and of a fine texture. It splits easily. It is not very durable as it is liable to blue stain and insect attack.

BOTANY. The leaf is simple, coriaceous, glabrous, elliptic, about $3\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad but often smaller, irregularly serrate especially towards the apex, bluntly acuminate, cuneate. The midrib is raised below and the nerves are fine and looped well within the margin. The petiole is about 0.4 in. long, slightly swollen and channelled above. The white, slightly scented flowers are in axillary racemes. The capsular fruit contains red arillate seeds.

PHENOLOGY. This is similar to thatof S. chevalieri.

DISTRIBUTION. See S. chevalieri. A tree of the lower stoey.

SEEDLING. Germination is epigeal. The hypocotyl is about $1\frac{1}{2}$ in. long, slender and finely pubescent. The cotyledons expand to become almost orbicular. They are thin, tri-nerved from the base, subsessile or with very short petioles. The primary leaves are alternate and the first one is about 0.4 in. above thecotyledons. The 2nd. leaf is oblong-lanceolate, about $1\frac{3}{4}$ in. long and $\frac{1}{2}$ in. broad, serrate in the upper half, acuminate and cuneate. The midrib is raised above and below; the nerves are very fine and looped. The petiole is short, brown and channelled above. The very small, linear stipules are caducous. The thin stem and the petioles are finely pubescent. Numerous seedlings are to be found under mother trees.



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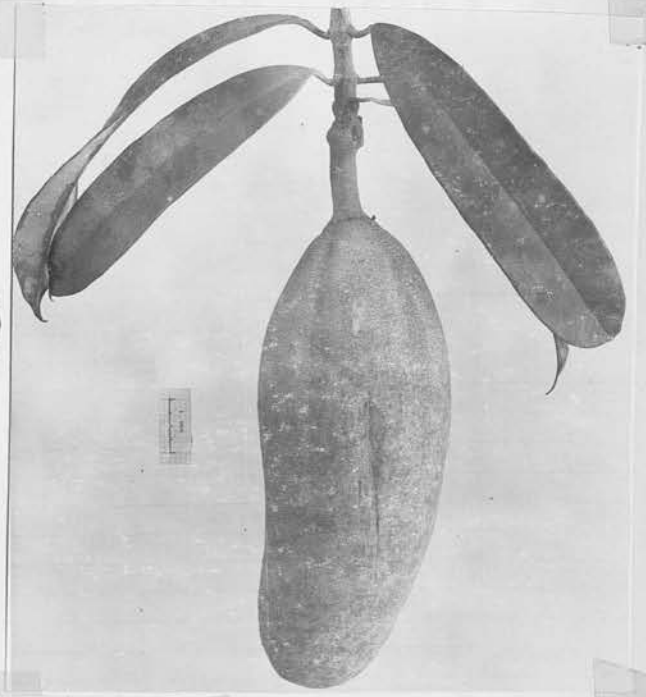

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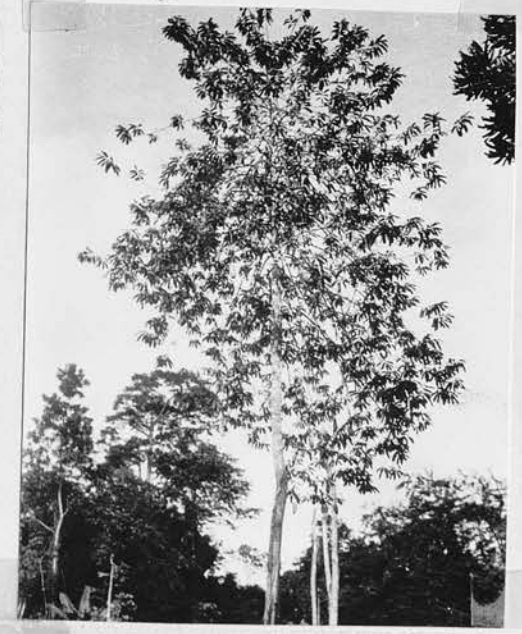


Allanblackia parviflora. 1.Leaf. 2.Seedling. Both x 1.
3.Fruit. 4.Tree.

GUTTIFERAE.

A family of trees and shrubs. In addition to those described below there is the exotic Calophyllum inophyllum L., a small to medium sized tree found growing in such different conditions as in sand near the beach at Esiama, in the Residential Area at Dunkwa, in Kpandu Plantation F.R. and at Tamale.

The leaves are simple, opposite, entire, thick, exstipulate, and with usually fine and more or less parallel nerves. The flowers are hermaphrodite or unisexual; the ovary is superior, often i-5 locular and with many ovules; the fruits are often large. The plants contain a resinous juice, sometimes coloured.

GENERA. 1. Allanblackia Oliv. 2. Garcinia L. 3. Mammea L. 4. Pentadesma Sabine 5. Symphonia L.

1. ALLANBLACKIA L.

Allanblackia parviflora A.Chev.

VERNACULAR NAMES. Anane (Nz). Bohwe (Ash). Soin (Nz). Sunkyi (W). The last name is derived from elephant's back, but the connection is not understood. It is a name sometimes applied to Pentadesma as the habits of the two trees are similar.

A small to medium sized tree. Although some individuals may grow bigger, the average tree is about 50 ft. high and 4 ft. G.B.H. One specimen felled in the Subri F.R. measured 43 ft. high, with a bole of 28 ft., and 4 ft. 7 in. G.B.H. The bole is straight, cylindrical and not buttressed. The crown is small and conspicuous with its numerous thin branches at right angles to the stem and pendulous at the ends where the leaves tend to be grouped. The dark bark is slightly scaly. The thin reddish slash contains an appearance of veining, and a colourless sticky juice appears in small quantities in the course of time. Eventually it forms as a clear gum on the wound, with a very pale green colour. The sapwood is light yellow and the heart light red, fairly hard and heavy, 56 lb. to the cu. ft. at 12% moisture content. It has a straight grain, is easy to work, and not resistant to decay. The seeds have been tested as a source of vegetable oil for confectionery, and are said to have possibilities.

BOTANY. The leaves are simple, opposite, elliptic, about 8½ in. long and 2 in. broad, coriaceous, glabrous, acuminate, broadly cuneate and exstipulate. The margin is entire, but usually turned over backwards. The midrib is prominently raised below and the numerous parallel nerves are just visible.

The petiole is short, about ½ in. long, thick and flattened above. The flowers are unisexual and are crowded at the ends of the branches. There are 5 sepals and 5 slightly pink, fleshy petals. In the male flower, the anthers are in bundles opposite the petals. The female has a superior unilocular ovary with many ovules. The fruit is up to about 15 in. long and 4 in. in diameter, pendulous, light brown, vaguely fluted and rounded at both ends. It contains many oil seeds. There are about 8 seeds to an ounce.

PHENOLOGY. The tree is evergreen. Flowering takes place from March to June. Fruits appear in August but are usually not ripe until October, and some remain on the trees until February. When mature, the fruits fall to the ground where they rot or are opened by small animals in the search of the seeds for food.

DISTRIBUTION & SILVICULTURE. This species is scattered throughout the High Forest Zone but has not been recorded from its northern margin nor Togoland. It is more frequent in the Rain Forest but is never common. It is a tree of the lower storey and is tolerant of shade.

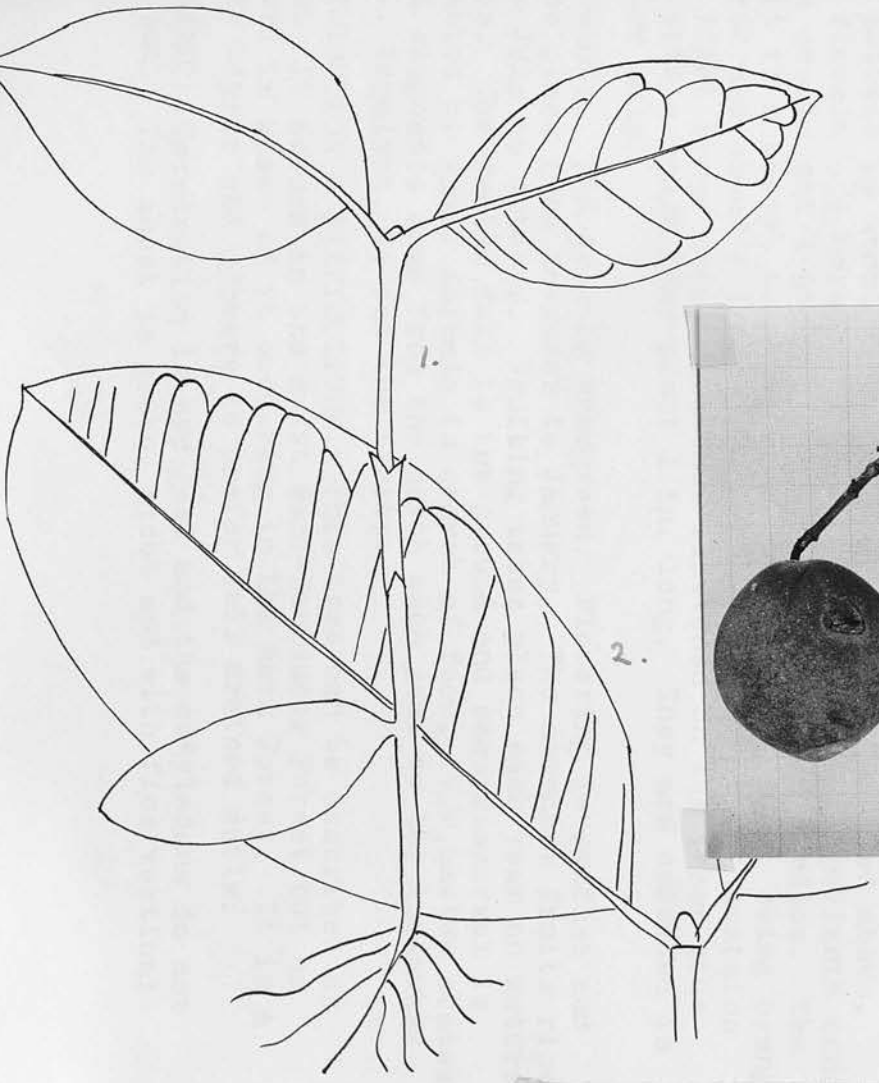
Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9
Ankasa River	120	77	11	2
Bonsa River	47	65	5	-
Dampia Range	59	90	2	-

SEEDLING. Germination is hypogeal. The shoot is stout, woody and dark purplish-brown. The first pair of leaves is about 6 in. above ground level. The leaves are opposite and decussate, glabrous, coriaceous, oblong-elliptic, about 4½ in. long and 1½ broad, entire, broadly acuminate and cuneate. The petiole is stout and about 0.3 in. long. The midrib is prominent below but the nerves are obscure. The new leaves and the terminal part of the shoot are deep red.

2. GARCINIA L.

In addition to the large tree described below, there are the following small trees: G. livingstonei T.And. in Riparian Woodland in the Northern Territorities, G. granulata Hutch.& Dalz. and G. polyantha Oliv. in the High Forest and G. mannii Oliv. in the High Forest and Riverain Forest.



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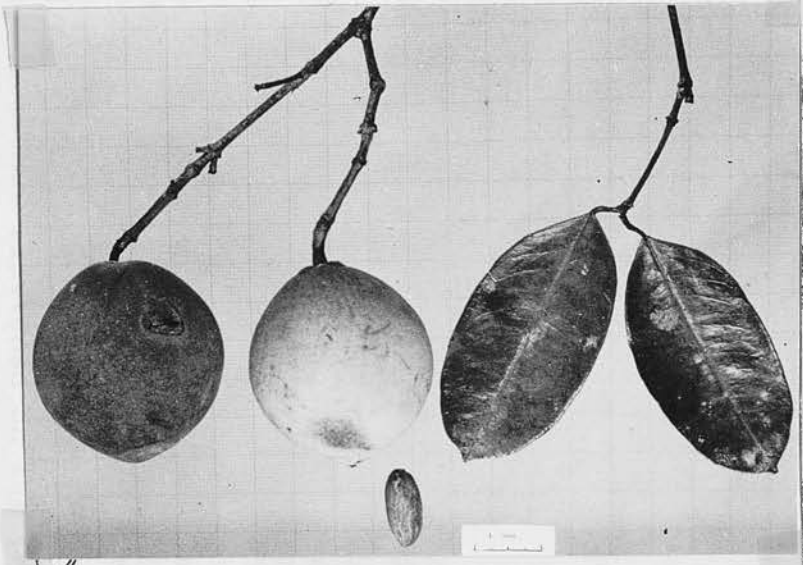
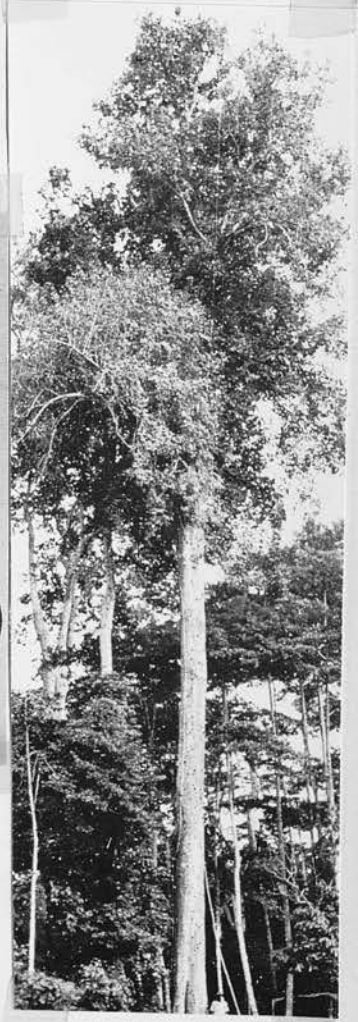




4.

Garcinia kola. 1.Seedling x 1. 2.Leaf x 1.
3.Leaves, fruits & seed. 4.Tree.

Garcinia kola Heckel

SYNONYMS G. conrauana Engl. G. dinklagei Engl.

VERNACULAR NAMES. Suapea (Nz). Twiapia (Ash,T,W).

This tree may rach a height of 100 ft. and a girth of 7 ft. One specimen in the Pra-Anum F.R. has an estimated height of 110 ft. with a bole of 50 ft. and a measured girth of 11 ft. 6 in. at a height of 7 ft. The bole is clear and cylindrical, and slightly buttressed close to the ground. The crown is dense, compact and deep, but not spreading. The bark is grey and slightly scaly. The slash is thick, granular and light brown. Pin points of yellow, sticky juice exude slowly. The sapwood is brown and so is the heart, which is hard and heavy and fairly resistant to termites. The wood is used as a chew-stick, and for this purpose small trees are felled , cut into short lengths and split into pieces about pencil thickness. The saids are said to provide an antidote for use against Strophanthus poisoning. They are also eaten like kola nuts.

BOTANY. The leaves are simple, opposite and exstipulate. The leaf is elliptic, about 4½ in. long and 2¼ in. broad, entire, with a short, blunt acumen and a broadly cuneate base, dark green, shiny and glabrous. The midrib is straw coloured and raised below, and the nerves are very fine and quite numerous. The petiole is about ½ in. long, dark and channelled above. The flowers are hermaphrodite and unisexual. The perianth consists of 4 sepals and 4 petals. The stamens are in 4 bundles. The fruit is a berry, coloured and shaped like a peach, being orange to red and about 4 in. long and 3 in. diameter. It contains 4-6 light brown seeds, somewhat flattened on the inner side and with a rough scar about 1 in. long. They are embedded in yellow pulp.

PHENOLOGY. The tree is evergreen. Flowering is profuse and takes place from November to January. The abundant fruits ripen from July to October. Fruiting takes place each year on mature trees. The fruits fall to the ground and seed dispersal is effected by small animals in search of food. R.M.Lawton states that elephants come from the north each year to the Asukawkaw F.R., Togoland, to eat the fruits.

DISTRIBUTION & SILVICULTURE. This tree can be described as rare. It occurs in the Moist Semi-Deciduous Forest but no record is known of it occurring in the Rain Forest. It is a shade bearer and appears to prefer well drained soils.

SEEDLING. Germination is hypogeal and the cotyledons do not open out. The shoot is green, stout and with fine vertical

ridges and light brown pubescence. The first pair of opposite leaves is about 2½ in. above ground. The leaf is oblong-elliptic, about 2 in. long and 1 in. broad, dull dark green, glabrous, entire, acute, rounded at the base. The nervation is visible on the underside, but is not prominent. The petiole is short and stout.

NATURAL REGENERATION. This is rare and is seldom seen.

ARTIFICIAL REGENERATION. There are about 40 seeds to 1 lb. Germination is good, but irregular, and takes place from 6 weeks to 18 months. R.M.Lawton reports from Togoland that a parcel of seeds was sown in November 1950. A few germinated in July-September 1951, and more by July 1952. Growth is slow and irregular; at the end of 2 years the plants may be 2-12 in. high. Usually they need to remain in the nursery for 3 years before transplanting. A strong taproot is formed and this requires undercutting before lifting. Stripped plants succeed in plantations, but require shade. This is a useful species for underplanting. Under suitable conditions it can be sown at stake, and this overcomes the difficulty of needing to cut the taproot, if transplants are used. It will tolerate a great deal of shade and grows slowly. One group of this species had an average height of 1 ft. 8 in. at 7 years. In the 1935 Taungya Plantation in the Pra-Anum F.R., G. kola seeds were sown at stake under a mixed tree crop. In 10 years the average height of this understorey crop was 4 ft.

3. MAMMEA L.

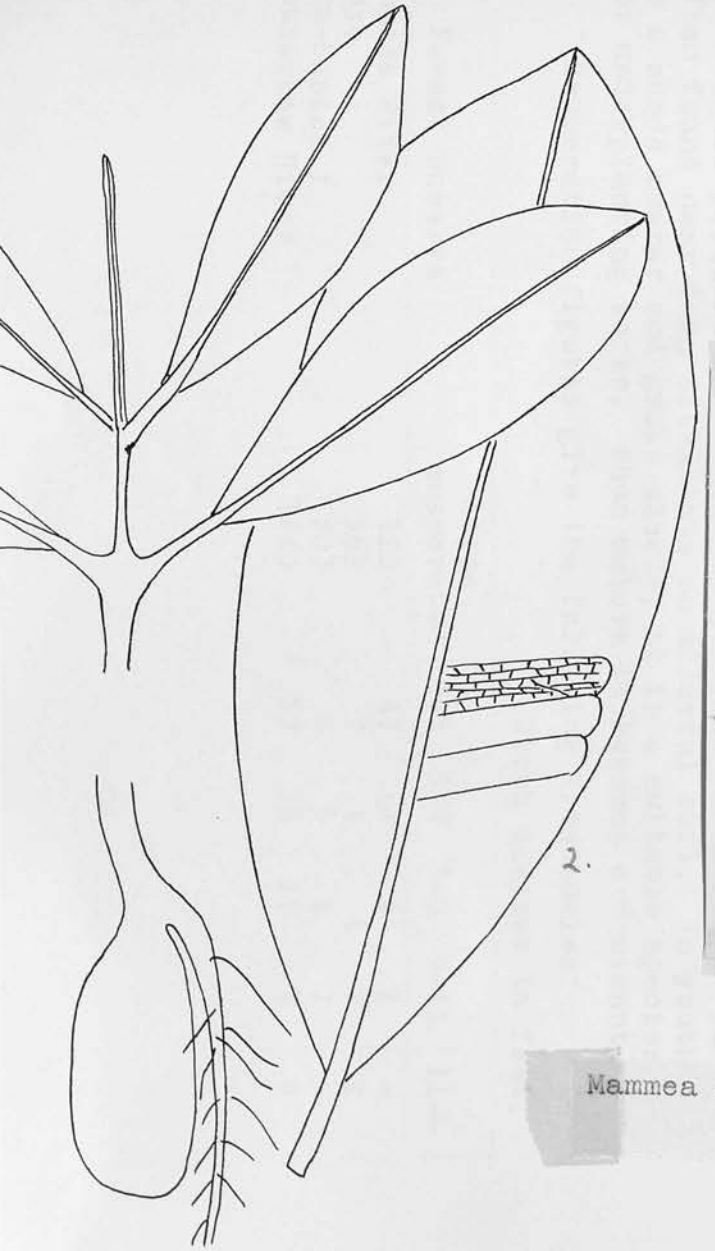
Mammea africana Sabine

SYNONYMS. M. ebboro Pierre M. gilletii De Wild. Ochrocarpus africanus Oliv.

VERNACULAR NAMES. Abrompesowa (Ash). Apegya (Nz). Bompegya (Ash,T,W). Duforokoto (Ash). Pasin (S). Pegya (W).

TRADE NAME. African Mammee-Apple.

A tall tree which may reach a height of 130 ft. and a girth of about 8 ft. The bole is long, straight, cylindrical and slender, and is slightly buttressed. The crown is dense and composed of small branches at the top of the tree. The bark on the young bole is mustard coloured and contains many scattered lenticels. On the older tree it is dark brown, rough and scaling off to leave shallow pits. The thick slash is pinkish-brown to red, and from it exudes a yellow sticky juice in drops. The heart isdark red-brown, about 49 lb. per cu. ft. at 15% moisture content, with a coarse texture and moderately hard and durable. An untreated piece lasted 9¼ years in a graveyard test.



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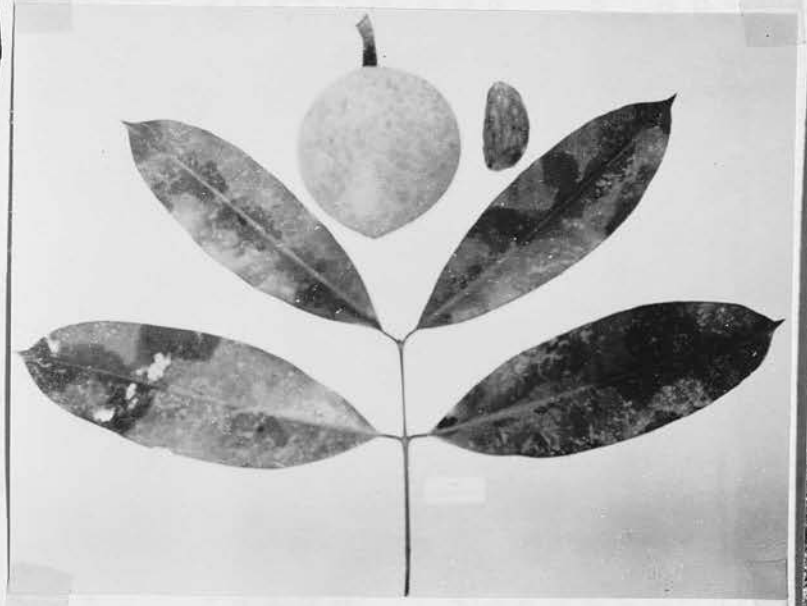


4.

Mammea africana. 1.Seedling x 1. 2.Leaf x 1.
3.Leaves, fruit & seed. 4.Tree.

In transverse section, many small vessels wit gum deposits, and the fine and numerous medullary rays may be seen with a hand lens. The wood has been used in bridging on the Essiama-Half Assini road. An infusion from the bark is used to cure skin itch.

BOTANY. The leaves are opposite, glabrous, coriaceous, exstipulate and droop on the large trees. The leaf is oblong-elliptic, about 10 in. long and 3 in. broad, with a short, broad acumen, cuneate, entire and with a stout petiole, about ½ in. long and slightly flattened above. The midrib is prominent below, but the nerves are very fine, parallel and faint. There is a white marginal nerve. The flowers are hermaphrodite and male. There are 2 red sepals and 4 white petals. In the male the stamens are numerous. The fruit is a large yellow berry, globose, about 4 in. diameter, with irregularly spaced brown spots on the outside. It contains 2-4 seeds embedded in a sweet smelling stringy pulp. The seed is large, about 2¼ in. long, very hard and rough, convex on one side and flat on the other.

PHENOLOGY. The tree is evergreen. New leaves flush a deep red. Flowering and fruiting occur each year but are irregular in that there is often a tree with flowers or fruits when the rest are without. The principal flowering period is June to November, and the ripe fruits are available from January to March, or earlier. The fruits drop to the ground and the rotting pulp is liked by snails for food. Animals eat the oily seeds.

DISTRIBUTION & SILVICULTURE. M. africana is found throughout the High Forest Zone. Although widespread it is never common, but is more frequent in the Rain Forest than elsewhere. It is often found near damp situations on alluvial soil. In youth it is a shade bearer and grows slowly; it is a suitable species for underplanting works. When mature it becomes a dominant.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Ankasa River	120	47	14	4	1	-
Yoyo	569	2	4	1	2	1
Pra-Suhien I	203	8	5	4	1	-
Esukawkaw River	1440	53	16	17	7	2

SEEDLING. Germination is hypogeal. The cotyledons do not develop and remain inside the seed coat. The stem is fairly stout and the first pair of leaves is borne about 6 in. above ground. The leaf is simple, oblong-lanceolate, about 3 in. long and 1 in. broad, obtuse, cuneate and with a petiole about 0.3 in. long. The midrib is prominent below. The stem, petioles and young leaves are purplish-red ar first and the leaves soft.

NATURAL REGENERATION. This is not often seen, but its occurrence is more usual in moist places. It is conspicuous because of the very deep red tip of the shoot and the red flush of the new leaves. Height growth is variable, but a sapling growing in fairly open conditions, in a moist soil, may put on 24 in. a year.

ARTIFICIAL REGENERATION. There areabout 12 seeds to a pound. Germination is irregular and may take up to 8 months. The average germination period is about 52 days, and 72%-90% germination can be expected. In the nursery, a height growth of about 1 ft. 4 in. is usual in 6 months, 2 ft. 3 in. in a year, and 5 ft. in 2½ years. The seedlings benefit from light overhead shade. This species is most useful for underplanting purposes. Stripped 1½-2 year plants may be used or the seed sown at stake. Growth is slow and irregular, but the plants can stand a considerable amount of shade and continue to grow straight even although slowly. In the 1935 Taungya Plantation in the Pra-Anum F.R., the M. africana used as transplants were about 15 ft. high in 14 years and in a very healthy condition. A small pure plantation in Kumasi when 13 years old had trees ranging from 15-28 ft. high and 5 in. - 1 ft. 5½ in. G.B.H.

4. PENTADESMA Sabine

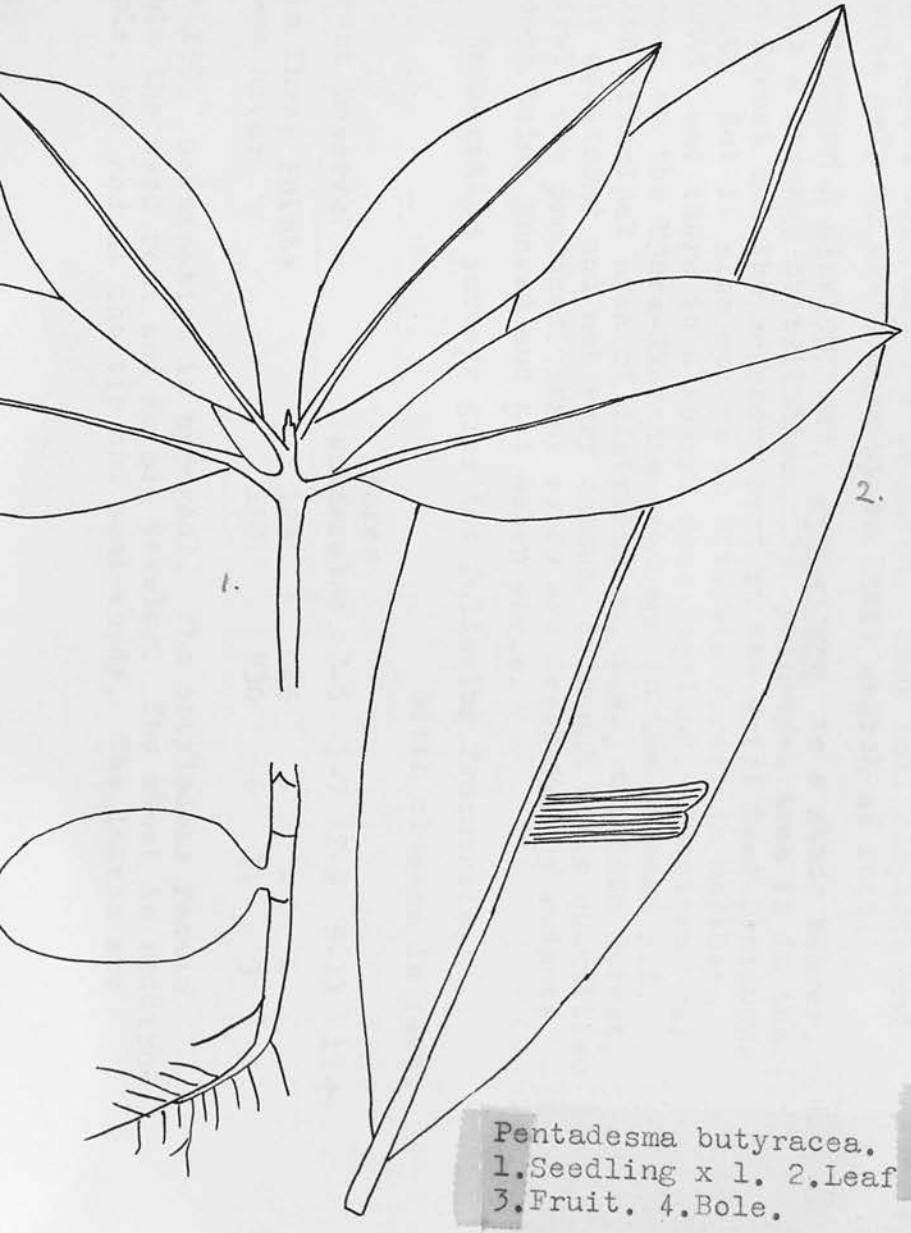
Pentadesma butyracea Sabine

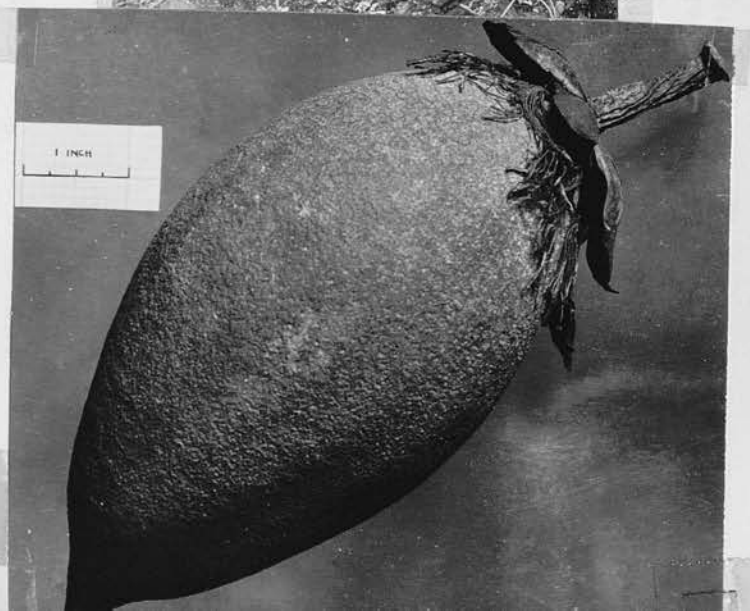
SYNONYMS. P. kerstingii Engl. P. leucantha A.Chev.

VERNACULAR NAMES. Abotuasabie (W). Asuaindokum (Ao). Bromabine (Nz). Ehuka (Nz). Peigya (W). Soinankaw (Nz). Sunkyi (W).

Some of these names are also applied to Allanblackia and Mammea.

A tall slender tree which is often about 90 ft. high and 8 ft. G.B.H. One specimen felled in the Subri F.R. was 96 ft. high (72 ft. bole and 14 ft. crown) and 8 ft. 4 in. G.B.H. The bole is straight and clear, and has small buttresses when old. It is topped by a small crown of thin, more or less horizontal branches, which may droop at their ends. The bark is grey and fissured, and may be so dark at times that it can be termed black. When horizontal fissuring develops, the bark is cut up into numerous small rectangles. The slash is red-brown, from which exudes a yellow to orange sticky juice; it appears as dots in the slash. The sapwood is white and the





Pentadesma butyracea.
1.Seedling x 1. 2.Leaf x 1.
3.Fruit. 4.Bole.

heart light brown. It is about 53 lb. per cu. ft. at 12% moisture content, moderately hard, with a coarse texture, and fairly resistant to termites. In transverse section, the few, small vessels are barely visible, but continuous bands of parenchyma are very prominent. Poles are used in mines, and from the oily seeds a native soap is sometimes made.

BOTANY. The leaves are simple, opposite and exstipulate. The leaf is oblong-lanceolate, about 10 in. long and 2½ in. broad, with a short acumen, cuneate and entire. The petiole is about 0.4 in. long, thick and flattened above. The midrib is brown and prominently raised below, and the numerous very fine and parallel nerves are just visible. The lamina is dark green and shiny above and a lighter green below. The large white, pendulous, terminal flowers are hermaphrodite and have their parts in 5's. The stamens are numerous but are in 5 bundles. The fruit is brown, inverted pear shaped, pendulous and large, about 5 in. long and 4 in. diameter. At the apex there are often the relics of the styles, and the sepals and some of the stamens persist at the base. Inside are about 15 seeds embedded in a yellow pulp.

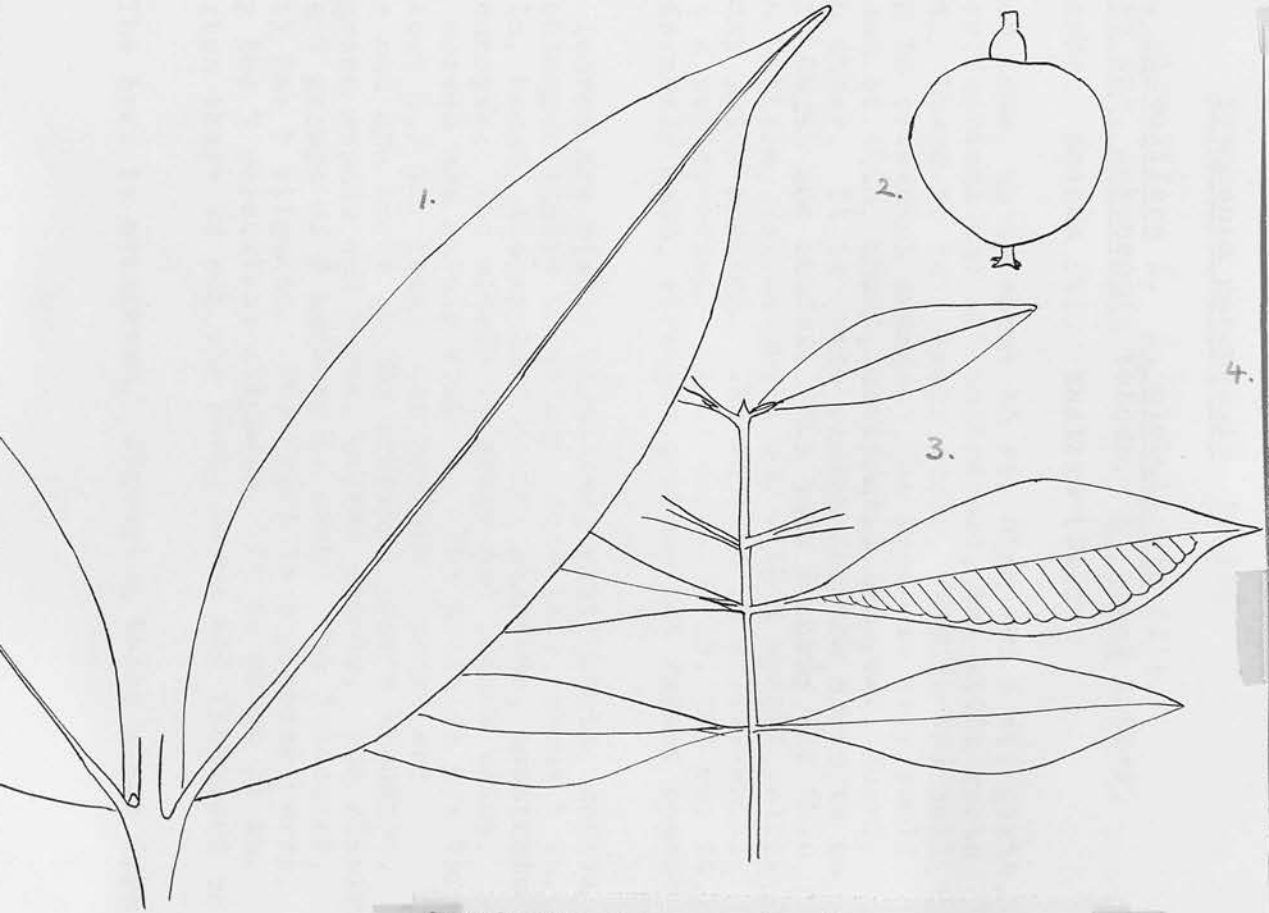
PHENOLOGY. The tree is evergreen. Flowering is somewhat irregular, but the main flowering season is March to July. The flowers are conspicuous on the trees, and so are the pendulous, large fruits from October to March. They fall complete and rodents help to break them up in their search of food.

DISTRIBUTION & SILVICULTURE. Pentadesma is a shade bearer. It has a strange distribution. Its principal area is in the Rain Forest and the adjacent part of the Moist Semi-Deciduous Forest. But it also occurs in Riverain Forest in northern Ashanti, and there is a record from Togoland. Specimens may be seen on the Ejura-Nkoranza road and in the Bosomoa F.R. In its principal area of distribution, i.e., the Rain Forest, it is scattered and not very common, although large quantities of fruit are produced. Many seeds are destroyed by rodents through being gnawed and not eaten whole.

Enumeration surveys give the following frequencies:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Cape Three Points	129	46	-	-	-	-
Ankasa River	120	230	6	11	3	-

SEEDLING. Germination is hypogeal. The cotyledons remain within the seed coat and do not develop. The shoot is reddish-purple, but red at the tip and semi-woody. The leaves are



Symphonia gabonensis. 1.Leaf. 2.Fruit.
3.Seedling. All x 1. 4.Tree.

simple and opposite and the first pair is borne about 8 in. above the ground. The leaf is reddish-bronze, becoming green, oblong-lanceolate, about 3 in. long and 1¼ in. broad, entire, acuminate, cuneate, glabrous and exstipulate. The red, stout petioles are about 0.3 in. long. A long tap root is produced.

ARTIFICIAL REGENERATION. Germination is irregular and periods of 38-181 days have been obtained. Growth is also irregular. Heights varying between 8 in. and 5 ft. 7 in. have been recorded at 2 years. In a small plantation, 10 years old, the trees ranged from 6 ft. 7 in. to 27 ft. high and 2 in. to 1 ft. 3 in. G.B.H.

5. SYMPHONIA L.

Symphonia gabonensis Pierre

SYNONYMS. S. globulifera L. S. globulifera Oliv. S. globulifera var. gabonensis Vesque. S. rosea A.Chev.

VERNACULAR NAMES. Ahurke (W). Ehulike (Nz).

A slender tree, up to about 90 ft. high and 6 ft. girth. The bole is cylindrical and not buttressed, but stilt roots may be formed. These do not always occur, even in the tall trees growing in permanent swamps. The crown is very small and is composed of thin, short, horizontal branches, fairly close to each other. It is quite common for the crown to be only 10 ft. in depth and radius. The bark is grey and thin, and the slash brittle, yellow-white and with a bright yellow, slightly sticky juice exuding. The sapwood is yellow-white, and the heart a yellow-brown. It is about 35 lb. per cu. ft., seasoned, moderately hard, straight grained but rather coarse in texture.

BOTANY. The leaves are simple, opposite, exstipulate, entire, coriaceous, oblong-elliptic to oblong-lanceolate, about 5 in. long and 1¾ in. broad, glossy dark green, glabrous, acuminate and broadly cuneate. The midrib is green and raised below. The numerous nerves are barely visible. The petioles are thick and short, about 0.3 in. long. The profuse flowers are hermaphrodite and are borne on the previous year's branches. There are 5 green sepals and 5 red, curved petals. The staminal tube contains 5 groups of 3 anthers in each. The 5-locular, superior ovary has 5 stigmata. The fruit is a globose berry, surmounted by the 5 persistent stigmata. It is about 1½ in. diameter. Often there is but one seed, brown and flattened on one side.

PHENOLOGY. The tree is evergreen. Flowering takes place from

about mid March to June. It is annual and plentiful. The fruits are available from about the end of August to December, but it is surprising how many of them fall immature. These are soon attacked by insects.

DISTRIBUTION & SILVICULTURE. S. gabonensis is found growing in freshwater swamps in the Rain Forest in particular, and in the area of the Moist Semi-Deciduous Forest adjacent to it. It is conspicuous in these swamps as it is usually taller than the rest of the vegetation and has a remarkably slender form and small crown. Often it is semi-gregarious. It may also be found in the moist areas on the edges of swamps, but never far from them. There is an isolated record of a specimen (Vigne F.H.2971) occurring at Obuom Mine on the west side of Bosumtwi Range F.R.

SEEDLING. Germination is hypogeal. The shoot is green, woody and glabrous. The leaves are simple and opposite, the first pair being formed about 3½ in. above ground. The leaf is lanceolate to oblanceolate, about 2 in. long and 0.6 in. broad in the first pair, entire, acuminate, attenuated at the base and with a petiole about 0.15 in. long. The lamina is dull green above and lighter below. The midrib is raised below; the nerves are fine and looped into a sub-marginal nerve.

HUMIRIACEAE.

A very small family which has but one representative in the Gold Coast.

SACOGLOTTIS Mart.

Sacoglottis gabonensis Urban

SYNONYMS. Aubrya gabonensis Baill. A. occidentalis A.Chev.

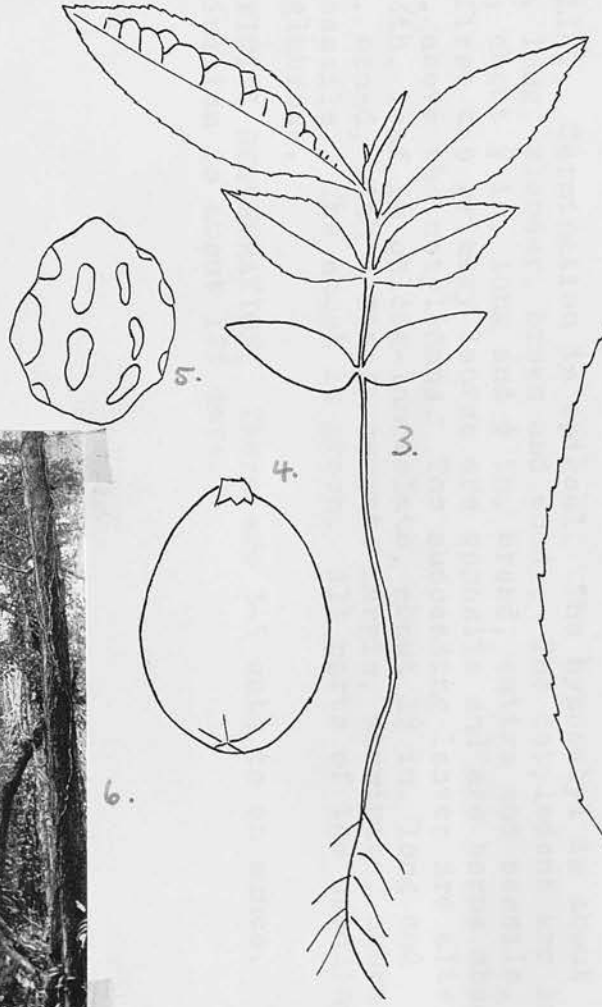
VERNACULAR NAMES. Afamkokoo (W). Fawire (Nz). Sometimes Tiabutuo (W) is used, but this is really Scottellia.

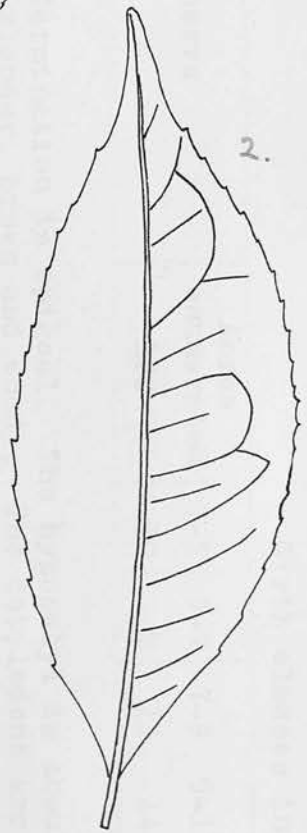
TRADE NAME. Ozouga.

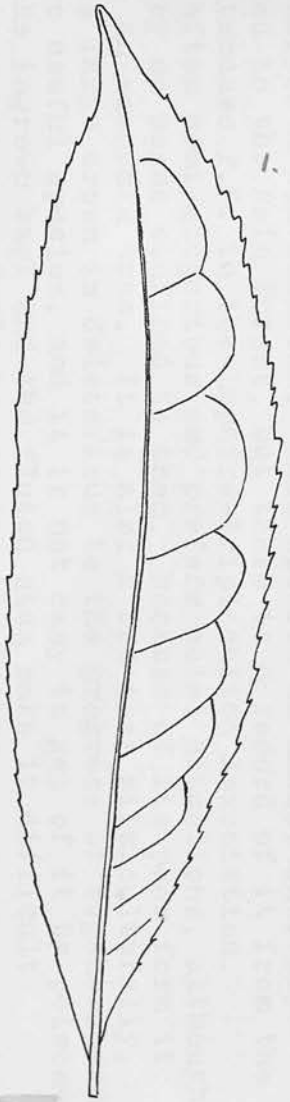
A tree of 90-120 ft. in height and about 12 ft. girth above buttresses. The bole is buttressed, badly fluted and twisted, with ingrown bark, and is quite a monstrosity at times. The crown is large, fairly dense and deep, and consists of heavy branches. The bark is reddish-brown, with long, thin, irregular scales and numerous, prominent lenticels. The slash is thin, fibrous and dull red-brown and exudes a slightly sticky sap. It produces a hissing sound for a minute ot two after cutting, which resembles the sound of a simmering pot or roasting beef. The sapwood is white to dull yellow-brown. The heart is brown, hard and heavy, 50-58 lb. per cu. ft. air dry, and durable. The tree is said to provide a good firewood. The poles are sometimes used in native houses.

BOTANY. The leaves are simple, alternate, glabrous, oblong-lanceolate, about 4 in. long and 1½ in. broad, lightly serrate, acuminate and cuneate. The petiole is slender, about 0.2 in. long, flattened above, swollen at the base and with light horizontal scars. The midrib is slightly raised above and more so below; the nerves are very fine and the venation is reticulate. The juvenile leaves are narrowly lanceolate and longer than the adult ones. The small white flowers are in axillary cymes. The calyx is 5 lobed and there are 5 white petals, 10 versatile stamens of unequal length and a superior 5 locular ovary. The fruit is an ellipsoid, almost globose, drupe, about 1.7 in. long and 1.4 in. diameter, with a soft, light coloured mesocarp with a dull scent, and a very hard reddish endocarp with warted longitudinal ridges.

PHENOLOGY. The tree is evergreen. Flowering takes place in December and January, and the fruits are ripe from July to September. They fall beneath the parent tree and are a source of food for small animals, particularly rodents. Many of the







Sacoglottis gabonensis. 1.Juvenile leaf x 2/3.
2.Leaf. 3.Seedling. 4.Fruit. 5.Seed. All x 1. 6.Bole.

fruits are bored by insects.

DISTRIBUTION & SILVICULTURE. This species is almost entirely confined to the Rain Forest, but there is a record of it from the Asin Atandaso F.R. in the Lophira-Triplochiton Association. It is often semi-gregarious and prefers moist situations, although it is by no means confined to them. Because of its poor form it is not an economic tree. It is also a bad tree silviculturally, for its large crown is deleterious to the progress of regeneration of more useful species, and it is not easy to get of it by poisoning; the ingrown bark and the fluted stem make it difficult to cut a continuous frill to receive the poison.

An enumeration survey gives the folowing frequencies:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Ankasa River	120	10	9	13	14	16

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long, slender, brown and woody. The cotyledons are lanceolate, about $\frac{3}{4}$ in. long and $\frac{1}{4}$ in. broad, entire and sessile. The first two primary leaves are opposite and are borne about $\frac{1}{2}$ in. above the cotyledons. The succeeding leaves are alternate. The 4th. leaf is oblong-lanceolate, about $1\frac{3}{4}$ in. long and $\frac{1}{2}$ in. broad, with a finely serrate margin, acuminate, cuneate and sessile. The shoot is green. All parts of the seedling are glabrous.

ARTIFICIAL REGENERATION. There are 3-5 nuts to an ounce. The germination is about 125 days.

LECYTHIDACEAE.

Besides the genus described below there is Napoleona P.Beauv. with 2 species on the Gold Coast - N. parviflora Baf.f., a small tree of the High Forest lower storey, and N. vogelii Hk.& Planch. a similar tree of the Antiaris-Chlorophora Association and Riverain Forest of the southern Savannah-Woodland.

COMBRETODENDRON A.Chev.

Combretodendron africanum (Welw.) Exell.

SYNONYMS. C. viridiflora A.Chev. Petersia africana Welw.
P. viridiflora A.Chev.

VERNACULAR NAME. Esia (Ash,D,F,Nz,T,W).

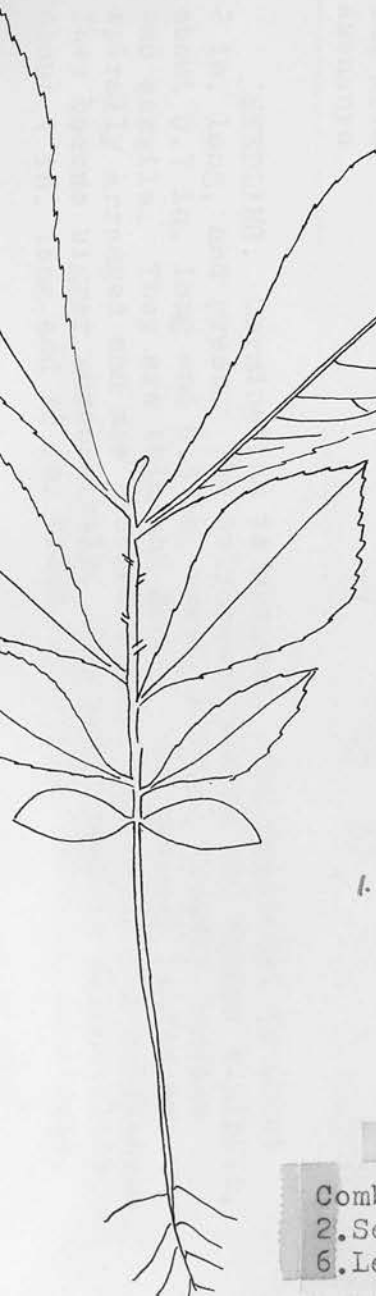
TRADE NAME. Esia.

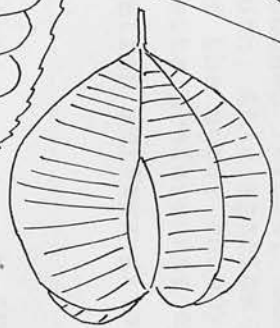
A tall tree not often exceeding 10 ft. G.B.H. Two specimen trees gave the following measuremnts when felled:

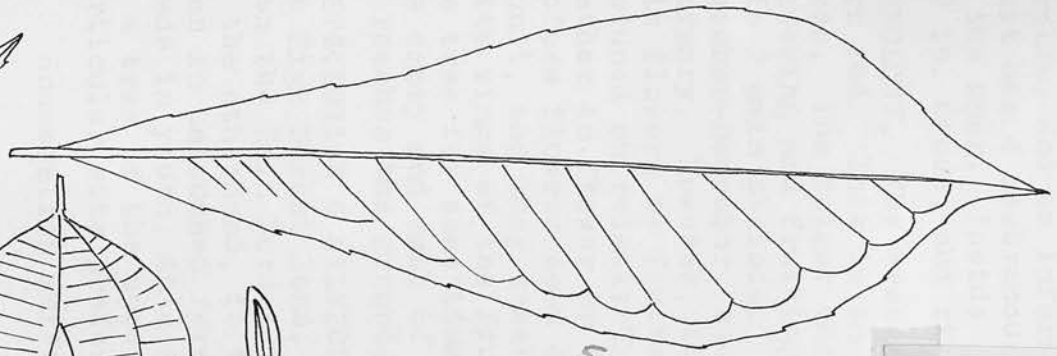
Girth breast height		Length of bole		Height of tree.	
7 ft.	10 in.	105 ft.	10 in.	152 ft.	4 in.
12	4	99	6	172	8

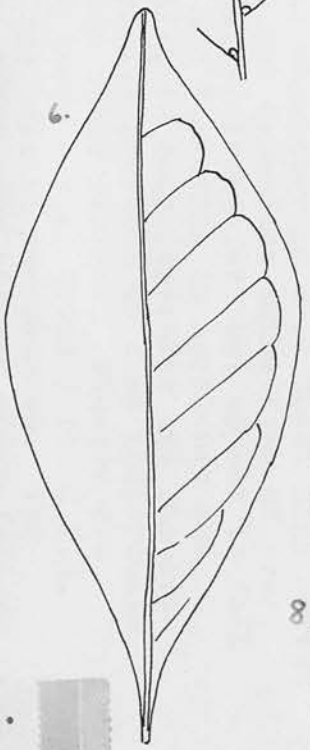
The bole is straight and usually tapering. There are no buttresses, but small root spurs may develop. The crown is well developed, but not spreading. The light grey bark is rather characteristic because of its colour and the regular fissuring which has an elongated diamond pattern. The slash is cream coloured, thick and very fibrous. When fresh the wood has a horrible smell of decaying cabbage. The sapwood is greyish-yellow and the heart reddish-brown. The heartwood is moderately heavy, 54 lb. per cu. ft. at 12% moisture content. It is odourless when seasoned. Seasoning has to take place slowly to prevent splitting. The texture of the wood is medium to coarse. It is not very resistant to fungal decay. In transverse section, growth rings are visible and also fine short and long bands of parenchyma. The very fine medullary rays and the fairly regularly spaced vessels, each with its ring of parenchyma, may be seen with a hand lens. The wood is used for firewood by Ashanti Goldfields Corporation Ltd. at Obuasi.

BOTANY. The leaves are simple, alternate, exstipulate, obovate, about 4 in. long and 1¾ in. broad, obscurely serrate when young, acuminate, cuneate and glabrous. The petiole is about 0.3 in. long. In most of the nerve axils on the underside of the leaf is a gland, visible to the naked eye. The juvenile leaf is obovate, about 5½ in. long and 1¾ in. broad, obscurely serrate, acuminate, attenuated at the base and glabrous. The flowers









Combretodendron africanum. 1.Fruiting branchlet.
2.Seedling. 3.Fruit. 4.Seed. 5.Juvenile leaf.
6.Leaf. All x 1. 7.Glands in nerve axils. 8.Tree.

are in axillary racemes and consist of 4 sepals, 4 white and not pleasantly scented petals, numerous stamens attached to the corolla, and an inferior, 2-locular ovary. The small fusiform fruit has 4 membranous wings which are reticulate and emarginate at the apex. Inside is a single seed, about 0.7 in. long and 0.2 in. broad, and ribbed vertically.

PHENOLOGY. The tree is evergreen. Before leaves are shed they turn red. This is an unusual character in Gold Coast High Forest trees. The colour change is not depandent onthe time of year. Flowering and fruiting are rather irregular, but appear to fall into 2 main periods. These are flowering in April-May and November-December, and fruiting in July-September and January-February. However, it is usually possible to find individuals with flowers or fruits outside rhese periods. Flowers are produced on relatively young trees - i.e. those 3 ft. G.B.H. Whether in flower or fruit, the tree is conspicuous. The profuse flowers soon drop the petals and stamens which fall as a unit, and they create quite a shower under the tree. The almost white wings of the fruits are readily seen, and they remain on the tree for some time - 3 months or more. Many of the fruits are empty and much of the seed that is formed soon rots once it reaches the ground. The fruits are wind distributed.

DISTRIBUTION & SILVICULTURE. C. africanum is found throughout the High Forest Zone. Its frequency diminishes, in general, from the Rain Forest to the Antiaris-Chlorophora Association. On the otherhand, it is more common in old Secondary Forest than in untouched forest. Although capable of enduring some shade in youth, this species is a moderate light demander and is a tree of the upper canopy. It does not seem to have any particular site preferences except avoiding swampy areas.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Bonsa River	81	60	25	11	5	-
Kakum	508	382	146	126	60	14
Dampia Range	59	63	12	9	2	2
Oda River	436	658	147	105	64	37
Asenanyo	77	17	17	4	1	-

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long, and green. The cotyledons expand and become elliptic, about 0.7 in. long and 0.3 in. broad, obtuse, broadly cuneate and sessile. They are thin and green. The primary leaves are spirally arranged and are crowded immediately above the cotyledons. They become bigger successively. The 10th. leaf is oblanceolate, about 4 in. long and 1¼ in. broad, glabrous, serrate, acuminate,

attenuated at the base, with a short, thin petiole, or subsessile. The midrib is fine and slightly raised above and below. The nerves are fine and regular. The taproot is long and smells of garlic.

NATURAL REGENERATION. Much of the seed aborts, and so there is comparatively little regeneration despite the large amount of fruits seen on the trees. Most of the natural regeneration is found in slight openings in the forest.

ARTIFICIAL REGENERATION. There are about 300 seeds to an ounce. The germination period is about 22 days.

MELIACEAE.

Economically this is the most important family of trees in the Gold Coast. From them are obtained such well known timbers as African Mahogany, African Cedar, African Walnut and Avodiré, which form a large proportion of the export timber trade.

The leaves are alternate, exstipulate, and usually pinnate and large. The flowers are hermaphrodite, regular and small, with the parts in 4's or 5's and the stamens double that number. The stamens are often united in a tube like a corona. The ovary is superior and the fruit is often a capsule, elongated or globose. The seeds may be winged or wingless. Germination may be hypogeal or epigeal.

Among those not described below are Carapa procera DC, a small badly shaped understorey tree of the High Forest, where it is often associated with moist situations, and also in the Riverain Forest of the southern Savannah-Woodland; Pseudocedrela kotschyi Harms, a tree ofthe Savannah-Woodland; and Trichilia L., with one species in the Savannah-Woodland and three in the High Forest, two of which, T. heudelotii Planch. and T. prieuriana A.Juss. are very common understorey trees. In addition, there are two exotics worthy of note. Azadirachta indica A.Juss., a small tree very useful as a firewood, is to be found throughout the Gold Coast, and does best where there is not too much rainfall. Cedrela mexicana M.Roem. is a very fast growing tree in the High Forest.

GENERA. 1. Entandrophragma C.DC. 2. Guarea L. 3. Khaya A.Juss. 4. Lovoa Harms 5. Turraeanthus Baill.

1. ENTANDROPHRAGMA C.DC.

SPECIES. (i) E. angolense (Welw.) C.DC. (ii) E. candollei Harms (iii) E. cylindricum Sprague (iv) E. utile Sprague

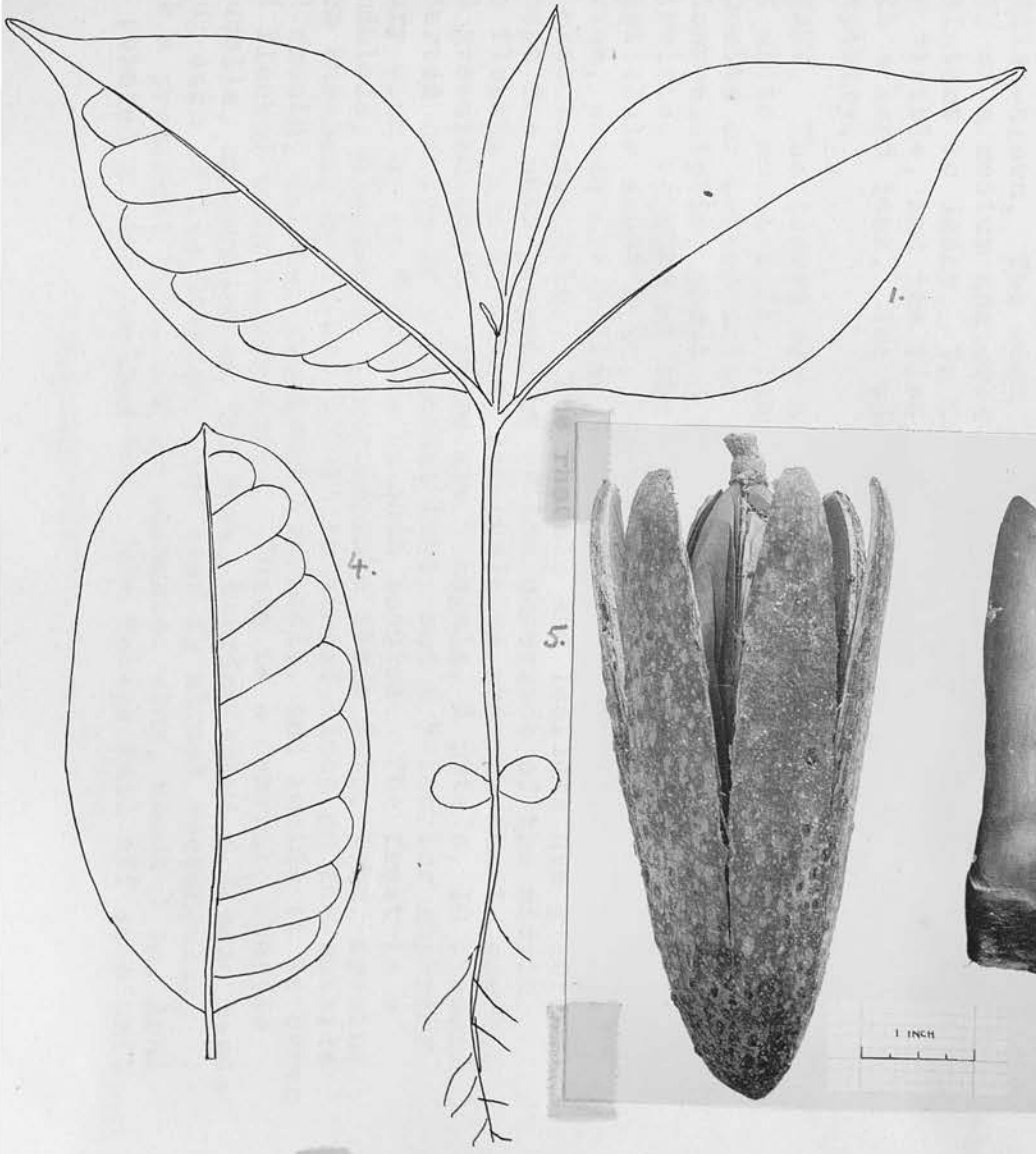
(i) Entandrophragme angolense (Welw.) C.DC.

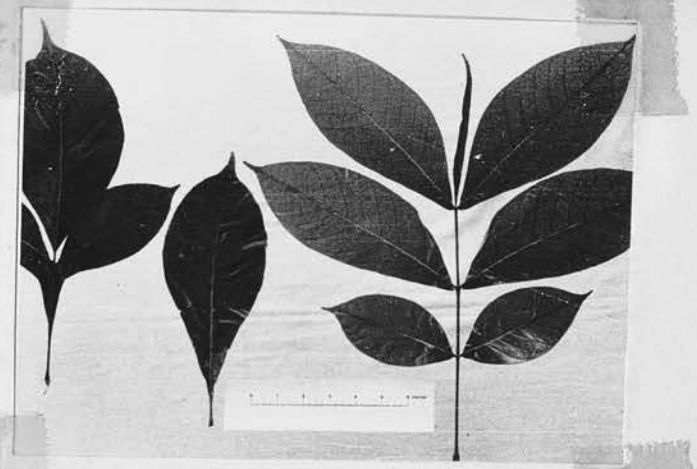
SYNONYMS. E. macrophyllum A.Chev. E. pierrei A.Chev. E. septentrionale A.Chev. Leipotyx congensis Pierre Swietenia angolensis Welw.

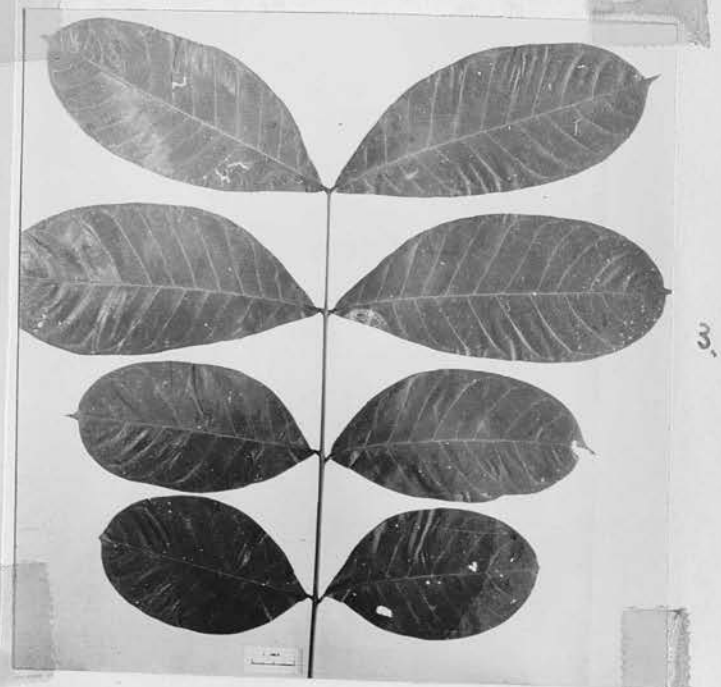
VERNACULAR NAMES. Dukuma (Nz). Edinam (Ash,F,T,W). Tiamatama (Nz).

TRADE NAME. Gedu Nohor.

This is one of the emergent trees in the High Forest, with a girth of about 15 ft. above buttresses. This is slightly







Entandrophragma angolense. 1.Seedling x 1. 2.Seedling leaves.
3.Sapling leaf. 4.Leaflet x 1. 5.Fruit & seed.

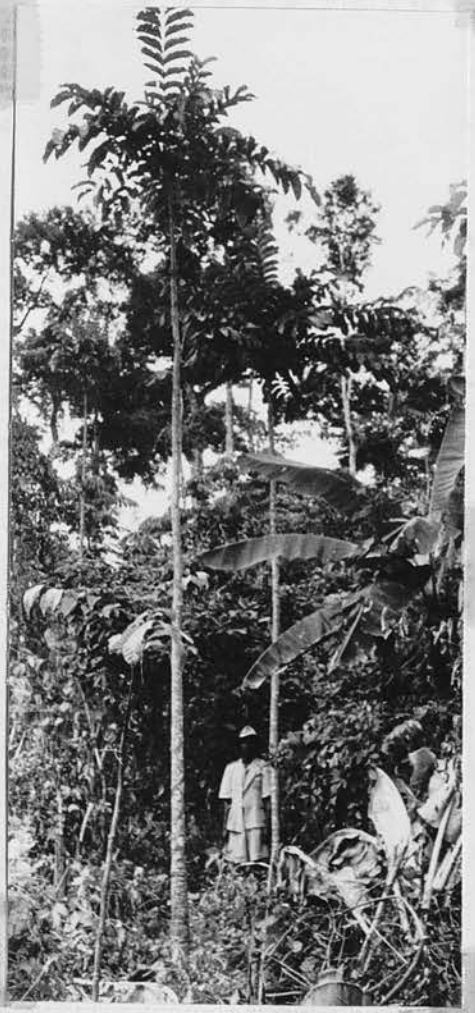
less than the other species of Entandrophragma. Felled trees provide the following details:

Girth above buttresses	Bole length	Height of tree	Volume over bark
14ft. 4in.	104ft. 0in.	187ft. 5in.	1,063 cu.ft.
14 8	85 2	195 0	1,131
14 10	93 6	169 4	1,107
16 8	98 4	188 7	1,668

The stem is usually not as straight as the other Entandrophragma spp., and has a slight bend in it, and may be somewhat elliptical in cross-section. The buttresses are thick, but not usually above 6 ft. high. Large surface roots run out from the buttresses and may be some 15 in. above ground. The crown is not big. It is dark and the branches are heavy. The bark has a smooth, grey and brown blotchy appearance caused by thelarge, irregular, smooth, thin scales, which peel off in large pieces on the older trees. The slash is thick, red, not scented and bitter to the taste. The sapwood is pale pink and the heart reddish-brown. The wood is about 32-36 lb. per cu. ft., air dry, of a medium and even texture, polishes well and is moderately resistant to decay. In transverse section, the small vessels are visible, and the fine, numerous medullary rays can be seen with a hand lens. The wood is in demand for furniture and carpentry.

BOTANY. The leaves are alternate, exstipulate, paripinnate and up to about 1 ft. long. There are about 14 pairs of opposite or sub-opposite leaflets. The leaflet is simple, oblong-elliptic, about 3 in. long and $1\frac{3}{4}$ in. broad, entire, apiculate, rounded at the base, dark green and shiny, and with a petiolule about $\frac{1}{4}$ in. long. There are about 7-10 pairs of nerves, which are yellow, raised below and looped. The midrib is also raised below. The rhachis and leaflets are glabrous except for some pubescence on the underside of the midrib. The flowers are in large, lax panicles and are small, scented and greenish-white. There are 5 sepals, 5 petals, 10 stamens inserted on top of a staminal tube, and a 5-locular superior ovary with up to 8 ovules in each loculus. The fruit is a pendulous, elongated, woody capsule about 7 in. long, opening from the base by 5 valves. It is almost black on the outside and smooth, without prominent lenticels, and inside it is brown and flecked with darker brown. There is a central, sessile columella, attenuated at the base, bearing about 6 winged seeds along each of its 5 faces. The seed is almost rectangular, with a prominent hilum and an elongated wing, about 3 in. long and pointed at the further end. The valves fall off as a unit

4.



2.

1.

3.

Entandrophragma angolense. 1.Characteristic blisters on pole. 2.Plantation crop 4 years old. 3.Bole. 4.Tree.

joined at the apex, and the naked columella is left hanging on the tree for some time.

PHENOLOGY. The deciduous period is from about mid September to November, although individuals begin to drop their leaves in August. With the flush of new leaves in December come the flowers, and these last until February, although some are to seen after this. The capsules begin to ripen in July and the fruiting season is usually over in November. While the tree is leafless the pendulous, opened fruits are conspicuous. Seed dispersal is by wind, but the seeds do not travel far from the mother trees.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone, except in Togoland. Two trees of this species have been seen in Togoland, one on the edge of Odomi village and the other in a coffee plantation on the outskirts of Vane. Neither is very old and it is possible that both were planted. There are a few saplings near the one at Vane. E. angolense is not common in the Rain Forest and the Lophira-Triplochiton Association. Its greatest frequency is in the other two Associations of the Moist Semi-Deciduous Forest. It is rare in Secondary Forest. In its first year or two the seedling requires shaded conditions, but the shade must not be too dense. Thereafter, overhead light is required for proper development. It prefers reasonably well drained soils and avoids moist situations where drainage is not free.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Subri	965	63	18	15	6	13
Kakum	508	124	39	23	31	26
Oda River	436	98	25	22	12	18
Bobiri	94	13	5	5	-	5
Afram Headwaters	185	12	5	6	2	1

SEEDLING. Germination is epigeal. The hypocotyl is often less than 1 in. long. The cotyledons do not develop and soon shrivel up. The first two primary leaves are borne about 2 in. above the cotyledons and are opposite. The succeeding leaves are alternate. The 3rd. leaf is simple, elliptic, about 3 in. long and 1½ in. broad, entire, acuminate, cuneate, glabrous, ex-stipulate and glossy green above. The colour of the lamina may be dark or light green depending on the intensity of the overhead shade. The petiole is short. Eventually compound leaves are formed, and this species is remarkable in its genus

as it produces simple leaves for a longer period than the other species do, and the metamorphosis from the simple to the paripinnate leaf is conspicuously shown. The beginning of the metamorphosis is indicated by either a lug at the base of the lamina, or a malformation at the apex. Changes follow rapidly in successive leaves, and the development of the rhachis and leaflets can be observed.

NATURAL REGENERATION. This is fairly common in good forest where there is a sufficiency of mother trees. The seedling is strong and a vigorous grower. This is particularly noticeable in the saplings which are robust looking, straight, unbranched and with an annual height increment of often about 2 ft. The current year's shoot is light, glossy green, glabrous, thick and bears lenticels. The remainder of the young stem is a shiny brown. The base of the sapling stem has the diagnostic feature of being swollen and warted. The young paripinnate leaves are up to 3 ft. long.

This species is being successfully regenerated under the Tropical Shelterwood System. The gradual opening of the canopy is particularly favourable for the Entandrophragmas and Khayas.

Recorded heights in Tropical Shelterwood System regeneration plots are as follows:

1st. year	2nd. year	3rd. year	4th. year
13in.	17in.	27in.	55in.
7	20	63	138
12	30	62	109
8	14	46	120
9	23	47	95
12	27	34	86

ARTIFICIAL REGENERATION. There are about 65 winged seeds to an ounce. Germination takes place in 14-23 days, and about 80-90% of the seeds germinate. The seed does not keep longer than about 3 months, and so the best results are obtained from fresh seed. When sown under light shade in the nursery, the seedlings are about 15 in. high at the end of 6 months, and 3 ft. at the end of a year, when the plant percentage should be not less than 75. In 18 months they are about 3-5 ft. high, and in this condition they are ready for planting out as stripped plants. This species transplants with ease, and suffers few failures. It may be planted as stumped plants, but this method has no advantages over stripped plants except ease of transport. Striplings over 6 ft. high are too big for transplanting as they tend to throw out more than one leader.

E. angolense is showing signs of being a successful tree crop for taungya plantations. In the 1948 Taungya in the Pra-

Anum F.R., the 3-5 ft. planted stripped E. angolense were up to 17 ft. high and 12 in. G.B.H. in 4 years. The planting distance was 10ft. X 10ft., but in 4 years the small crowns were nowhere near forming a closed canopy. Because of the characteristically small crown, this tree requires a natural or planted understorey crop in plantations.

PATHOLOGY. This is a healthy species but 13 seedlings in a group in the Pra-Anum 1948 Taungya suffered die-back from a capsid attack in 1950-51.

(ii) Entandrophragma candollei Harms

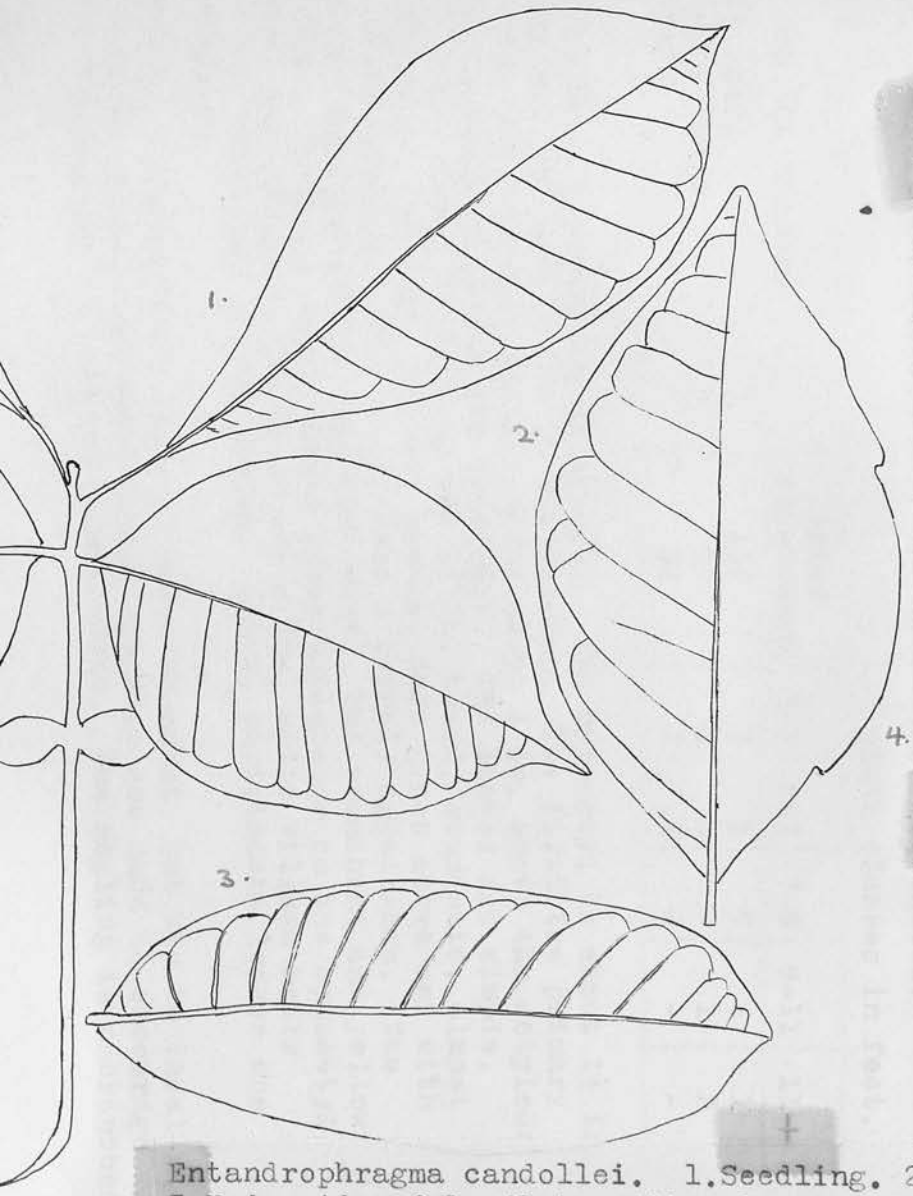
SYNONYM. E. ferrugineum A.Chev.

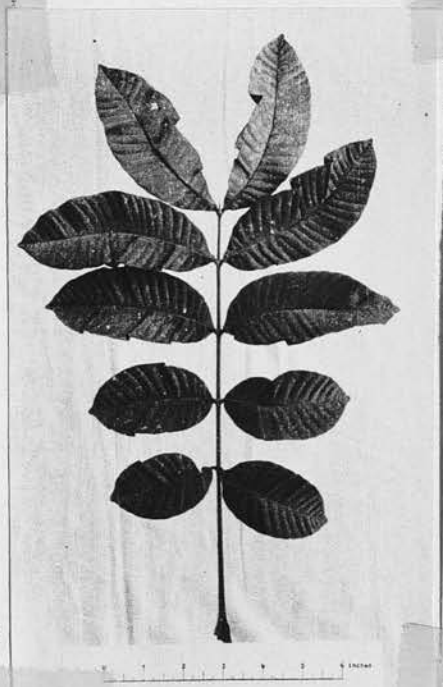
VERNACULAR NAME. None except the corrupted Sida (= cedar). It is usually mistaken for E. cylindricum.

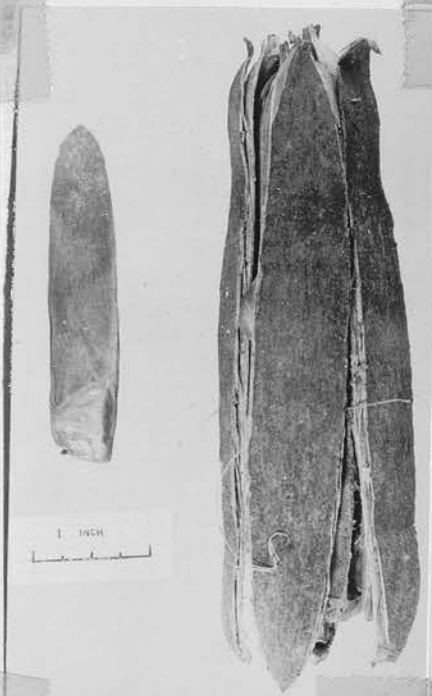
TRADE NAMES. West African Cedar. Heavy Sapele.

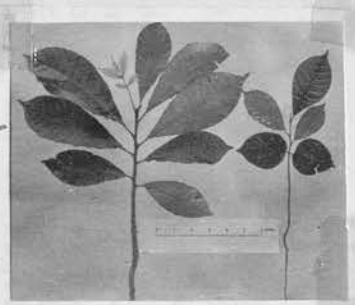
A dominant tree with a height of 160 ft. or more, and a girth of up to about 20 ft. A felled tree in the Pra-Anum F.R. measured 14 ft. girth above buttresses, 100ft. 6in. length of bole and a height of 167ft. 7in. The bole is tall, straight and cylindrical, and the buttresses are very slight and low. The crown is wide and spreading, and its dark appearance sometimes bears a resemblance to Khaya ivorensis. The bark is greyish to dull brown, shaggy, and flakes off irregularly to leave pock marks. The slash is thick, granular, pink-brown, bitter to the taste and not scented. The lack of scent distinguishes this species from E. cylindricum which it most resembles in other ways. There is a little exudation of gum. The sapwood is pale pink and is sharply defined from the heart which darkens from red to brown. The wood weighs about 41 lb. per cu. ft. at 13½% moisture content. It has a coarser texture than the wood of the other Entandrophragmas, and is not held in favour by the timber trade.

BOTANY. The leaves are alternate, paripinnate, exstipulate and about 12 in. long on the mature trees. There are about 4-8 pairs of opposite leaflets with very short, dark brown petiolules. The leaflet is simple, oblong-elliptic, about 3½ in. long and 1½ in. broad, entire, bluntly acuminate, broadly cuneate, dull dark green and coriaceous (papery in the juvenile stage). On the underside the pale yellow midrib and about 15 pairs of nerves are very prominent. The rhachis is flattened towards the base and it and the young shoots and buds are covered with a dark brown velvety indumentum, and there are a few brown hairs on the underside of the leaflet. The small flowers are in short axillary panicles. The fruit is a pendulous elongated wooden capsule about 7 in. long and valves are thinner than those of E. angolense and E. utile. The









Entandrophragma candollei. 1.Seedling. 2.Juvenile leaflet.
3.Underside of leaflet. All x 1. 4.Leaf. 5.Seedlings.
6.Fruit & seed. 7.Bole.

capsule is greyish-brown on the outside, fairly smooth, but olive-green-brown inside, with straw coloured edges. The 5 valves open from the apex. The columella has a stalk about ¾ in. long. The seeds are borne on the 5 faces of the columella. The seed and terminal wing are about 3½ in. long and ¾ in. broad, and are light greyish-brown and shiny. The seed is almost rectangular.

PHENOLOGY. Flowering and fruiting may be irregular for some individuals, but the flowers are usually produced from September to December; ripe fruits are available from January to March. Deciduousness is also variable and has been recorded in September, October, February and March. The capsules open on the trees and the seeds are dispersed by wind.

DISTRIBUTION & SILVICULTURE. This species is scattered throughout the High Forest Zone, but none has been recorded from Togoland. It appears to be rare in the Rain Forest, but is never present in quantity anywhere. It seems to be most frequent in the Enchi area, and it may be described as occasional in the Tano-Suhien F.R. and north of Begoro. It is not found in Secondary Forest. In its initial stages it requires a certain amount of overhead shade, but once it has reached its 2nd. year it requires more light for development.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Oda River	436	7	1	5	4	1
Dampia Range	59	1	-	-	1	2
Bobiri	94	2	1	±	-	-

SEEDLING. Germination is epigeal. The hypocotyl is about 1½ in. long and the cotyledons do not develop. The first two primary leaves are opposite and are borne about 1 in. above the cotyledons; the succeeding leaves are alternate. The leaves are simple, elliptic, about 3 in. long and 1¾ in. broad, acuminate, almost rounded at the base, entire, papery, dark green above and with a short petiole. The leaves have a crinkly appearance. The midrib and nerves are depressed above, but prominent and yellow below. There is short, dense brown pubescence on the hypocotyl, shoot and petioles and there are a few, white villose hairs on the underside of the lamina. Later, paripinnate leaves are developed.

NATURAL REGENERATION. This is never abundant, but may be locally frequent, especially where canopy openings are made to encourage the development of natural regeneration. The sapling is unbranched

and is conspicuous with its dark green, crinkly leaflets and the dark indumentum covering the terminal bud. With a sufficient amount of overhead light after its second year it develops rapidly and height increments of up to 3ft. 6in. have been recorded at this stage.

ARTIFICIAL REGENERATION. There are about 73 winged seeds to an ounce. The seed has short viability, and so sowings should take place soon after seed fall. Germination takes place in 13-20 days.

(ii) Entandrophragma cylindricum Sprague

SYNONYMS. E. rufa A.Chev. E. tomentosum A.Chev.
Pseudocedrela cylindrica Sprague

VERNACULAR NAMES. Mpengwa (Ao). Penkwa (Ash,F,T,W).

TRADE NAME. Sapele.

A dominant tree of the High Forest. Felled trees provide the following details:

Girth above buttresses	Bole length	Height of tree	Volume over bark
18ft. 0in.	89ft. 0in.	198ft. 4in.	1,048 cu.ft.
17 10	107 0	190 1	1,424
21 4	78 4	153 2	1,766
19 5	88 0	172 5	1,162

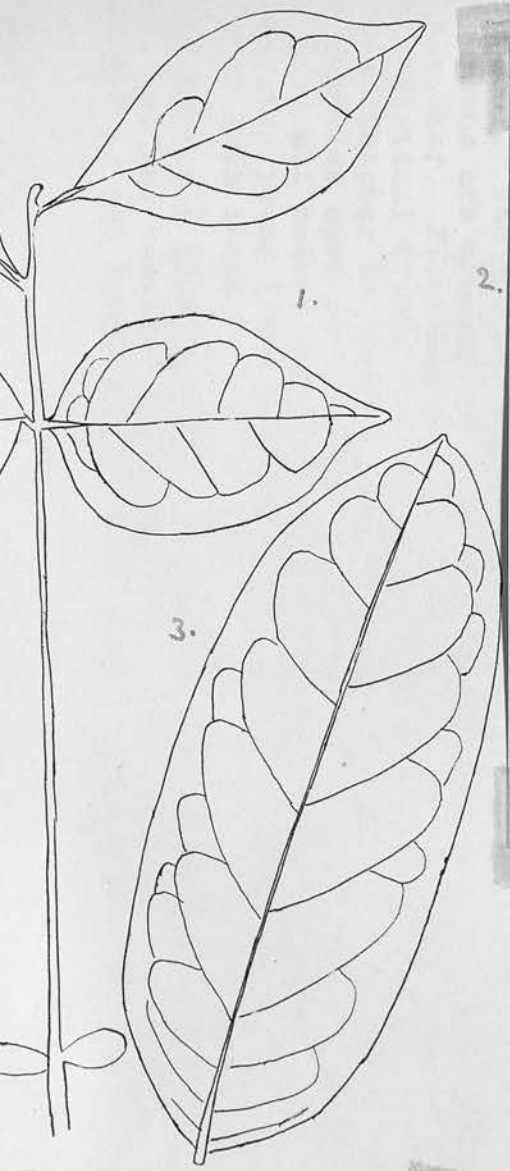
A tree felled in the Bobiri F.R. gave the following measurements:

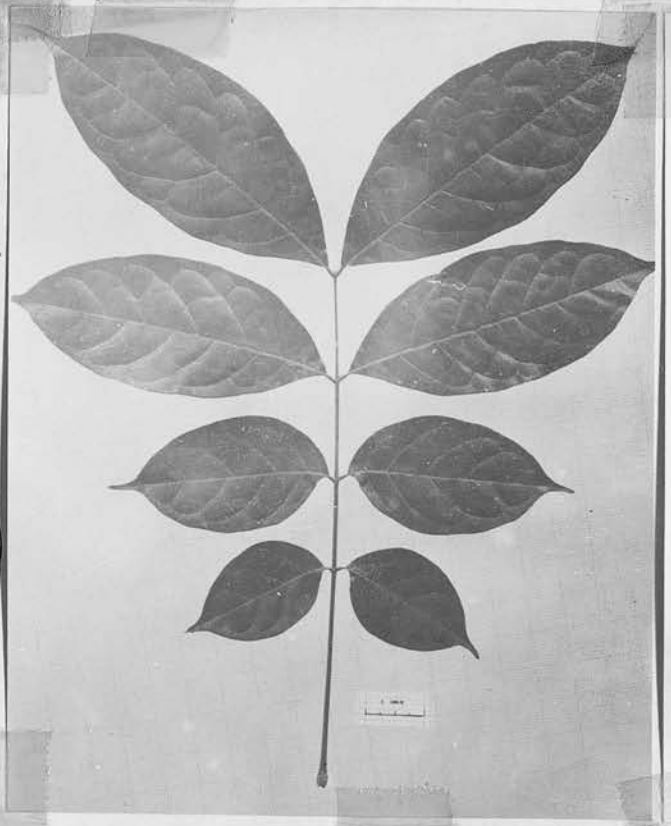
Height of stump	19ft. 0in.
Girth at felling point	13 3
Girth below crown	10 9
Length of merchantable bole	83 3
Length of crown	88 0
Height of tree	190 3

The logs obtained from it were as follows:

Length	Volume O.B.
16ft.2in.	268.9 cu.ft.
17 1	261.8
17 3	245.0
17 3	213.9
15 6	185.5
83 3	1,175.1

The stem is tall, cylindrical and straight. The buttresses are usually fairly short, but may reach up to about 10 ft. The crown is rounded and not spreading . The bark of trees of





Entandrophragma cylindricum. 1.Seedling.x 1.
2.Sapling leaf. 3.Leaflet x 1. 4.Seedlings.
5.Fruit & seed. 6.Bole.

about 7 ft. girth or less is usually a mustard grey or dull silvery colour, smooth and with a diamond pattern on it. Later it becomes scaly and shaggy brown. There are many scattered lenticels. The slash is moderately thick, slightly granular, pink discolouring to saffron-brown and scented. There may be ripple marks in the white sapwood. The heart darkens from red to reddish brown. The wood is about 40 lb. per cu. ft. at 15% moisture content, with a cedar scent which is lost in time, an even texture, good working qualities and is fairly resistant to decay. Usually it shows a regular stripe, especially when sawn on the quarter, and this is due to changes in direction of the grain. When the grain becomes confused, a more decorative blister effect is produced. In transverse section many scattered small vessels can be seen, and ripple marks are usually visible on the longitudinal section. The wood is much in demand for veneering, cabinet making and carpentry. Blister figure has an enhanced value.

BOTANY. The leaves are alternate, exstipulate and paripinnate, with about 6-7 pairs of sub-opposite, glabrous leaflets, and about 10 in. long on the mature tree. The leaflet is oblong, about 4 in. long and 1½ in. broad, entire, broadly apiculate, more or less rounded at the base but with equal sides. The mid-rib and nerves are raised below; there are about 8 pairs of fine and widely spaced nerves. The petiolule is very short. The rhachis is pubescent towards the base. The small, yellow-green flowers are in lax panicles. The fruit is an elongated woody capsule, 3-4 in. long and pendulous. The 5 thin valves are about ¾ in. broad and open from the apex and bend backwards. The valve is smooth and dark on the outside, and inside it is light brown and shiny, with darker flecks. The columella is sessile and broadest at the base. On its 5 faces are the seeds - up to about 6 on each.The brown seed is 2½-3½ in. long, with its terminal wing on which are the impressions of the other seeds. These impressions are due to the seeds being very tightly packed in this small capsuled Entandrophragma.

PHENOLOGY. The tree is deciduous in September and October, and the crowns are usually complete with their new leaves by the end of November. Flowering and fruiting may be somewhat irregulary for individual trees, but the principal period of flowering is from October to January, and fruiting from May to August. The capsules open on the trees and the seed is dispersed by wind but does not travel far. Monkeys eat the immature fruits. Relatively young trees may flower but do not usually produce seed at this stage.

DISTRIBUTION & SILVICULTURE. Found throughout the High Forest Zone, but not recorded from Togoland. It is rare in the south-west and is not found in Secondary Forest. Its greatest frequency

seems to be in the Celtis-Triplochiton Association. This species requires shade during its first two years and then needs overhead light for its proper development. Its growth is slow compared with the other species of Entandrophragma.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Subri	965	20	11	13	5	7
Kakum	150	11	7	6	4	5
Bøbiri	94	22	6	9	2	20
Bonkoni	170	3	4	8	11	36
Bia Tano	262	17	9	24	44	23

SEEDLING. Germination is epigeal. The hypocotyl is about 1 in. long and glabrous. The cotyledons do not develop. The first two leaves are borne about 3½ in. above the cotyledons. The succeeding leaves are alternate. The first leaf is simple, ovate, about 1¾ in. long and 1¼ in. broad, with a very short petiole. The 5th. leaf is simple, oblong-elliptic, about 3 in. long and 1¼ in. broad, entire, acuminate, cuneate, glossy green above and dull below, with a short petiole about 0.2 in. long. The midrib is raisedbelow, but the few nerves are not very conspicuous. There is brown pubescence on the shoot. The formation of paripinnate leaves depends to a certain extent on the amount of light falling on the seedling, but it is not delayed long. The leaflets usually increase in size towards the terminal pair.

Height measurements of seedlings in Tropical Shelterwood System regeneration plots are as follows:

1st. year	2nd. year	3rd. year	4th. year
7in.	10in.	26in.	38in.
8	14	32	50
6	10	26	35
11	13	22	37
9	16	23	34
6	18	28	37

NATURAL REGENERATION. In an area with more orless equal numbers of mother trees of E. angolense and E. cylindricum and E. utile, there is usually less regeneration of E. cylindricum than of the other two species. The seedling is less vigorous, and indeed is a slow grower compared with the other two species; it may have a height increment of 7-16 in. a year. It is not very liable to shoot borer attack.

ARTIFICIAL REGENERATION. There are about 70 winged seeds to an ounce. The seed has a notoriously short viability, but when it is sown as soon as collected, a germination percentage of about 90 may be obtained. Germination takes place in 14-26 days. The seedlings require light shade. Height growth in the first 6 months is about 7 in. and a year old seedling is about 16 in. high. A 3 ft. high plant is obtainable in two years.

This species has been used in Taungya Plantations. Stripped plants about 3-5 ft. high (2-3 years old) are favoured. Establishment is good, but height growth is not as great as with E. angolense.

(iv) Entandrophragma utile Sprague

SYNONYMS. E. macrocarpum A.Chev. E. ruburoides Verm.
Pseudocedrela utilis Dawe and Sprague

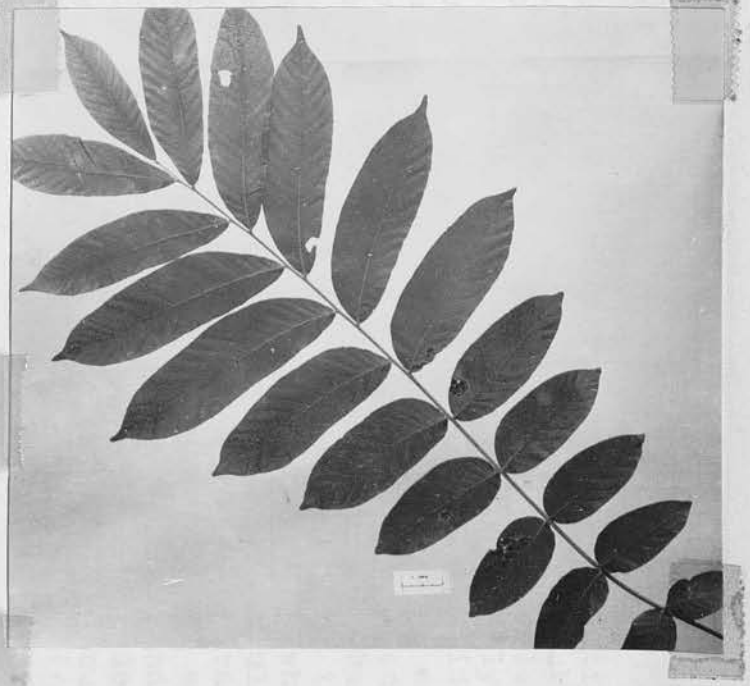
VERNACULAR NAME. Efuobrodigye (Ash,T). This means "monkey's roasted plantain" on account of monkeys eating the seeds and the resemblance of the unopened capsule to a roasted plantain.

TRADE NAME. Utile.

A large tree of the High Forest. Details of felled trees are as follows:

Girth above buttresses	Bole length	Height of tree	Volume over bark
19ft. 1in.	64ft. 3in.	133ft. 8in.	1,392 cu.ft.
19 6	98 0	173 5	1,510
21 5	84 8	187 5	1,859
24 0	77 0	190 8	1,771
25 6	88 11	170 1	1,880

Often this species reaches large dimensions. The bole is straight and cylindrical, often bifurcating into two huge branches at the top. The buttresses reach up to 15 ft. or more, but do not spread far from the tree. Stout surface roots are often developed. The crown consists of large branches and is spreading, but is not dense as the leaves are grouped at the ends of the branches and the leaflets droop. The bole is characteristic because of its light silver grey bark, and long, regular, vertical scales, 1 in. or more in width. The slash is brown in the outer layer and then bright pink-red. It is slightly scented. Vague ripple marks may sometimes be seen in the white sapwood. The heart is reddish-brown and slightly cedar scented when fresh. It is 36-40 lb. per cu. ft. when air dry. It has less interlocking grain than E. angolense and works well. In transverse section, scattered small vessels are visible and short, narrow, transverse bands of parenchyma may be seen with a hand lens. The wood is used in furniture making and



Entandrophragma utile. 1.Seedling x 1. 2.Seedling.
3.Sapling leaf. 4.Leaflet x 1.

general carpentry.

BOTANY. The leaves are alternate, paripinnate, exstipulate and about 15 in. long (more on young plants), with about 8-12 pairs of subopposite leaflets. The leaflet is simple, about $3\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. broad, oblong-ovate, gradually acuminate, more or less rounded at the base and with unequal sides. The petiolule is very short. The midrib and nerves are raised below and are pubescent. The lamina is dull green on the upper side. There are white villous hairs on the rhachis and it is flattened on the upper side at the base. The terminal buds are covered with brown tomentose hairs. The small white flowers are scented. The fruit is an elongated woody, pendulous capsule, about 8 in. long - the biggest among the Entandrophragmas. It is broadest at the apex, and on the outside is dark brown with small warts. The 5 thick valves open at the apex and remain attached to the columella at the base. On the inside they are shiny brown. The columella is sessile and bears about 6 winged seeds on each of its 5 faces. The wing is about 5 in. long and 1 in. broad, brown and papery. The seed is not rectangular and is borne towards the straighter side of the wing, near the oblique base.

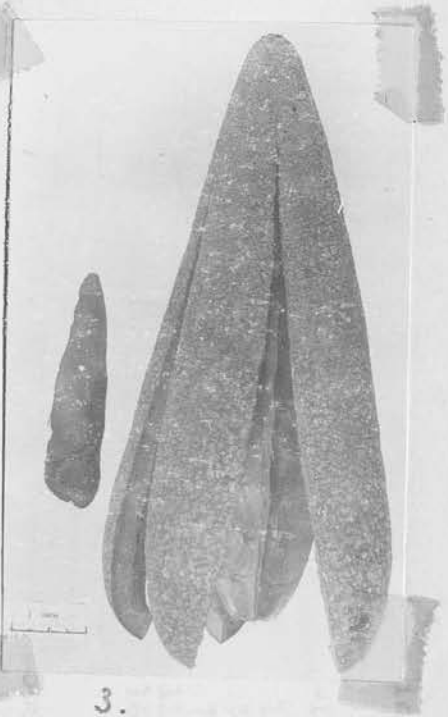
PHENOLOGY. Individuals are deciduous at various times from November to February. Flowering takes place from about December to March. The profuse flowers drop soon. Young capsules may be seen in April, but are not ripe till December to March. In fact, fruiting and flowering take place during the same period but are a year apart in age. The seeds are wind distributed but do not go very far from the mother trees.

DISTRIBUTION & SILVICULTURE. This Entandrophragma has a more limited distribution than the others. Besides being apparently absent from Togoland, it does not occur in the Rain Forest, nor the Lophira-Triplochiton Association, nor the southern part of the Celtis-Triplochiton Association. Its greatest frequency is in Ashanti, especially towards the north and in N.W. Sefwi. It is absnt from Secondary Forest. This species is a shade bearer in early youth, and requires shaded conditions longer than the other Entandrophragmas. Where the tree canopy is opened suddenly, the seedling leaves shrivel up and the plant may die. Later, it requires overhead light for its proper development, and eventually becomes a dominant. Its associates include Cistanthera papaverifera and Mansonia altissima.

Enumeration figures give the following frequencies:

1.

2.



3.

Entandrophragma utile. 1.Tree. 2.Bole. 3.Fruit & seed.

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Bobiri	94	2	-	2	1	9
Afram Headwaters	185	25	4	3	3	10
Tinte Bepo	110	1	1	1	7	8
Bonkoni	170	5	2	5	11	29
Bia Tano	262	7	6	4	16	51

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long and the cotyledons, which are auriculate at the base, do not develop. The first two primary leaves are about 1 in. above the cotyledons and opposite; The succeeding leaves are alternate. The 3rd. leaf is simple, elliptic, about 3½ in. long and 1½ in. broad, entire, acuminate, broadly cuneate, exstipulate, dull green and with a slightly crinkled appearance. The hypocotyl, shoot, petioles, midrib and nerves are pubescent. The nerves are raised below. The formation of compound leaves depends to a certain extent on the amount of light reaching the plant, but usually develop within the first 6 months. The first of the compound leaves are irregularly shaped.

NATURAL REGENERATION. This is usually plentiful - more so than with any other of the Entandrophragmas in their first year. It is slow growing at first, and even in areas treated under the Tropical Shelterwood System, the seedlings suffer a higher mortality than do those of E. angolense, which is a more vigorous species in youth. Once the sapling stage is reached, the rate of growth is increased, especially if there is sufficient overhead light; an annual height increment of about 15 in. is normal.

The following height measurements of seedlings are from Tropical Shelterwood System Regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
8in.	12in.	23in.	39in.
9	14	26	36
10	15	31	41
6	23	32	37
4	13	26	44
15	31	52	56

ARTIFICIAL REGENERATION. There are about 66 seeds to an ounce. About 75% of the seeds germinate and the period is about 13-19 days. It is advisable to sow the seed fresh, although it has been kept for 3 months and 60% germination obtained. In 6 months

the plants are about 15 in. high, and 2ft. 4in. in a year. They should be grown under screens in the nursery for if they are exposed to strong sunlight when young, the leaves curl, and even although the plants may not die, their progress will be considerably retarded. Plants 1½-2 years old are suitable for planting out. Either stumped ar stripped plants may be used, but the latter are now favoured. Growth in a plantation may be somewhat uneven.

2. GUAREA L.

SPECIES. (i) G. cedrata (A.Chev.) Pellegrin. (ii) G. thompsonii Sprague & Hutch.

(i) Guarea cedrata (A.Chev.) Pellegrin

SYNONYM. Trichilia cedrata A.Chev.

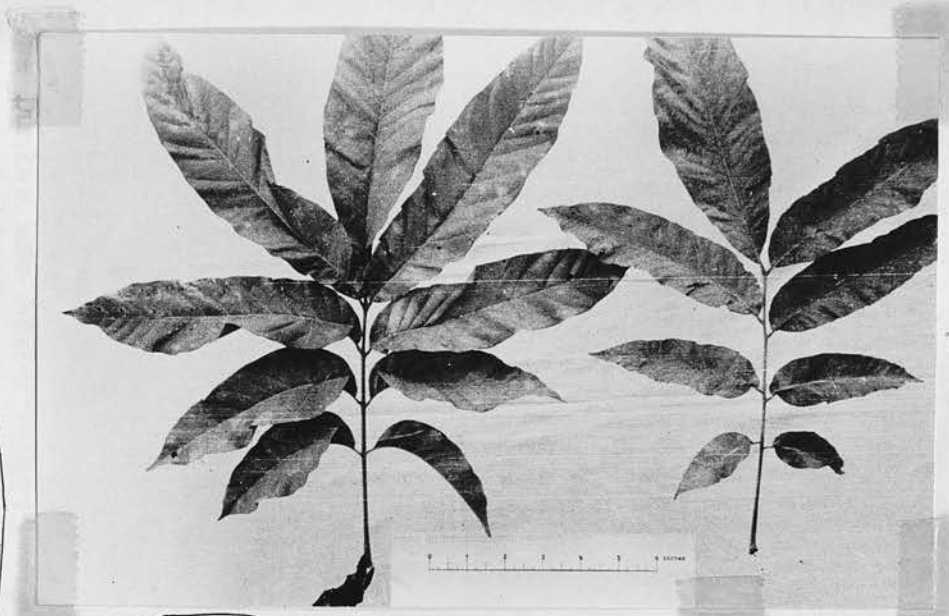
VERNACULAR NAMES. Bosse (Nz). Kwabohoro (Ash,F,T,W). Kwadwuma (W). Onwamdua (Ash). This last name is also applied to Maesopsis eminii and means "hornbill's tree" because the fruits are eaten by that bird.

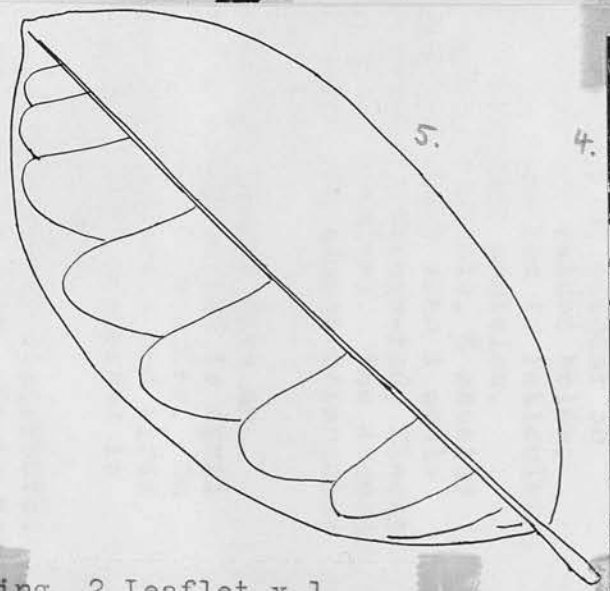
TRADE NAME. Scented Guarea.

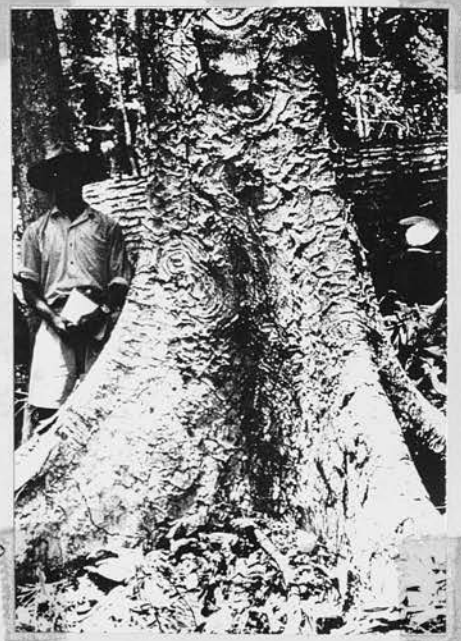
More often this is a medium sized tree, but the following measurements were taken of specimens felled by timber merchants.

Girth above buttresses	Length of bole	Height of tree
5ft. 10in.	80ft. 0in.	130ft. 0in.
5 0	67 0	110 0
14 8	76 10	167 8
17 6	70 6	177 1
15 7	76 10	182 6

The bole is straight and not often much above 9 ft. in girth. In the old trees there are short buttresses. The crown is dark and compact and at first glance resembles E. angolense. The bark is a light grey to mustard colour, slightly scaly when old, and the irregular, thin scales flake off to leave more or less rounded depressions, which often resemble shell-like markings. This character it shares with Afzelia, Canarium and Turraeanthus. The slash is thick, scented and without latex (cf. G. thompsonii), pinkish-brown, darkening on exposure. The sapwood is white. The pinkish-brown heart does not darken to the same extent as that of Entandrophragma and Khaya. The wood is about 38 lb. per cu. ft., air dry, with a cedar scent which fades in time, a finer texture than Entandrophragma and Khaya, moderately hard, polishes well and seasons well but slowly. In transverse section the numerous vessels are barely visible, and the parenchyma is banded transversely but irregularly. The many fine medullary rays may be seen with a hand lens. The wood veneers well and







Guarea cedrata. 1.Seedling. 2.Leaflet x 1.
3.Leaves. 4.Bole. G. thompsonii. 5.Leaflet x 1.

is in demand for cabinet making. The bark has medicinal properties and is used in cures for stomach ache and gonorrhoea.

BOTANY. The leaves are alternate, imparipinnate, with 3-6 pairs of leaflets and a terminal one, and exstipulate. The leaflets increase in size towards the terminal one. The leaf may be about 2 ft. long in the young plant and half that size on older trees. The rhachis is channelled above, thickened and slightly pubescent at the base. A lateral leaflet is simple, oblong to oblong-elliptic, about 4 in. long and 2½ in. broad, entire, glabrous, acuminate, cuneate at the base, but usually with unequal sides. The short petiolule, about 0.4 in. long, is swollen in the leaves of young plants but may be slender on older trees. The yellow midrib and nerves are raised below; the nerves are only fainly looped and the venation is reticulate. The small scented flowers are in short axillary panicles. There are 4 sepals which are much reduced, 4 petals, 8 sessile anthers on a staminal tube, and a superior ovary with i ovule in each of 4 loculi. The fruit is a globose, orange-red, fleshy capsule, about 1½ in. diameter, opening by 4 valves. The 4 seeds are embedded in an orange pulp. The seeds are almost triangular in shape, about 1 in. long and 0.6 in. broad.

PHENOLOGY. The tree is evergreen. The new leaves have an attractive red to bronze flush. The flowering period is April to August, and the fruits are ripe in October to December. On the trees the fruits are eaten by monkeys, squirrels and birds, and on the ground by duiker and porcupine. Seed dispersal is good, for natural regeneration is well distributed.

DISTRIBUTION & SILVICULTURE. This species is widely distributed on well drained soils throughout the High Forest Zone. It is never frequent, but appears to be at its best in the southern part of the Dunkwa and western part of the Tarkwa Forest Dostricts. It is remarkable how few mature trees there are compared with the large numbers of saplings and poles. In its young stages it can stand a great deal of shade, but once it gets sufficient overhead light, it grows quickly. It reaches the upper canopy but is seldom an emergent.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Pra-Suhien I	203	45	12	4	2	1
Kakum	508	106	44	42	22	6
Subri	965	38	5	7	6	2
Yoyo	569	24	7	3	3	4
Oda River	436	97	24	9	1	1
Bobiri	94	16	3	-	2	1

SEEDLING. Germination is hypogeal and the cotyledons do not develop. The first two leaves are opposite and are borne about 3 in. above ground. The succeeding leaves are alternate. These primary leaves may be simple or trifoliate, and their form seems to be conditioned by the amount of light they receive. If there is inadequate light, the leaves are simple. A first pair of trifoliate leaves may be followed by a simple one. Eventually imparipinnate leaves are formed, from which there is no retrogression. The leaflets of a trifoliate leaf are lanceolate; the middle one is slightly bigger than the two side ones. It is about 2 in. long and 0.6 in. broad, sessile, entire, acuminate and cuneate. The leaf petiole is about ½ in. long. The young leaves flush red. The shoot is dark green, somewhat flattened in the early stages and lightly pubescent. The root is red to straw coloured.

NATURAL REGENERATION. This is quite plentiful. Although essentially a shade bearer, it is remarkable the response in height growth there is when the canopy is opened. Recent natural regeneration works under the Tropical Shelterwood System have caused more or less stagnating saplings to put on height increments of about 20 in. a year. Similarly, the seedlings are thriving well under this partial opening of the canopy. Under normal forest conditions it seems that this species is content to stagnate, and only a few individuals make good. If given too much light, the sapling branches. The terminal bud like a goose's upturned neck, and the red to bronze colour of the new leaves make this species readily discernable in the young stages.

Seedlings in Tropical Shelterwood System regeneration plots gave the following measurements:

1st. year	2nd. year	3rd. year	4th. year
4in.	9in.	13in.	16in.
12	19	40	96
14	17	25	52
9	21	39	67
6	18	27	42

ARTIFICIAL REGENERATION. There are about 14 seeds to an punce. Germination is slow and irregular, but the period averages 36 days. It may be up to 2 months. At 6 months, a plant percentage of about 86 can be expected. Height growth is slow and may be 6 in. in 6 months, and 10-12 in. at the end of a year. Nursery plants require shade. In a small experimental plantation at Kumasi, the trees were 28-48 ft. high and 11-24 in. G.B.H. at 14 years.

(ii) Guarea thompsonii Sprague & Hutch.

VERNACULAR NAMES. Bosse (Nz). Kwadwuma (W). Kwantanuro (Ash).

TRADE NAME. Guarea.

This tree is similar to G. cedrata but is comparatively rare in the Gold Coast. Only the main differences between these two species are given below.

The slash is brown granular, not scented and exudes a small quantity of white latex. The wood is slightly heavier but milder to work than G. cedrata, and does not darken to the same extent. In transverse section the banded parenchyma is continuous and wavy. The few, small, scattered vessels and the numerous, fine medullary rays may be seen with a hand lens.

BOTANY. The imparipinnate leaf is slightly longer than that of G. cedrata. The leaflet is oblong-elliptic, about 4 in. long and 2 in. broad, entire, with a very short, blunt acumen, broadly cuneate and with a petiolule about 0.4 in. long. The lamina is dull and smooth above. The nerves are raised below but are fewer than those of G. cedrata - only about 10 pairs. Aubréville states ( ) that each loculus of the ovary contains 2 ovules whereas there is only one in G. cedrata.

DISTRIBUTION. There are records of specimens from the Ankasa, Subri, Pra-Suhien I, and Atewa Range F.Rs. It is therefore possible that this species is more inclined to the higher rainfall areas.

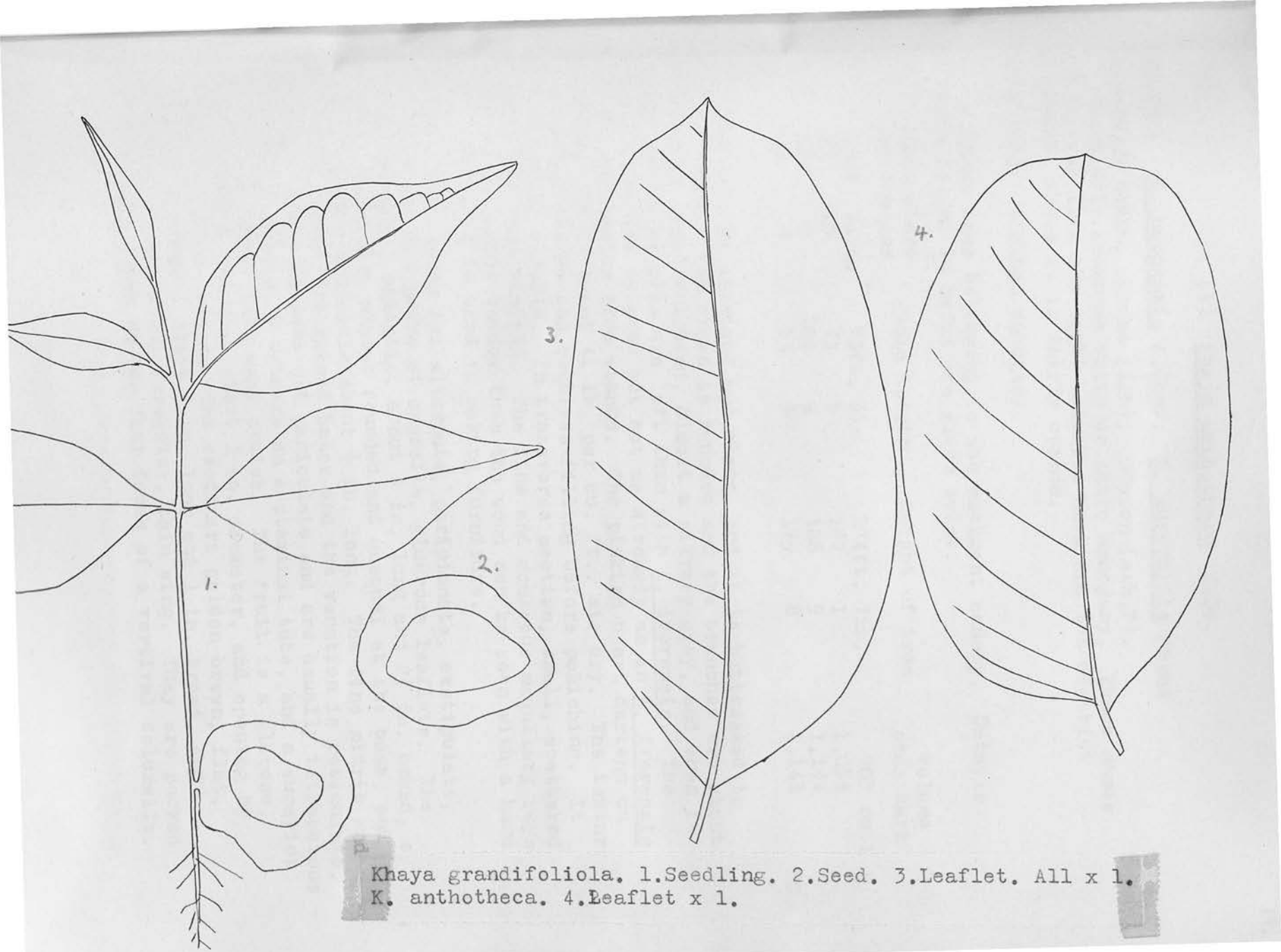
FIELD NOTES. The main distinguishing characters which separate this species from G. cedrata are the presence of latex in the slash and no scent, and the rather broader, less acuminate leaflet with fewer nerves and no reticulate venation. Because of the presence of latex, it is sometimes confused with Trichilia lanata A.Chev., but the densely pubescent underside of the leaflet of the latter readily distinguishes between these two species.

3. KHAYA A.Juss.

This genus is well known because it provides the timber known as African Mahogany. There are 4 species in the Gold Coast. K. senegalensis A.Juss. is a riparian tree of the Savannah-Woodland. The name of the genus is derived from the Senegambian name for this species.

SPECIES. (i) K. anthotheca C.DC. (ii) K. grandifoliola C.DC. (iii) K.ivorensis A.Chev.

The vernacular names are not really specific.



Khaya grandifoliola. 1.Seedling. 2.Seed. 3.Leaflet. All x 1.
K. anthotheca. 4.Leaflet x 1.

(i) Khaya anthotheca C.DC.

SYNONYMS. K. agboensis A.Chev. K. euryphylla Harms

VERNACULAR NAMES. Kruba (Ash). Odupon (Ash,T).
Popularly known as White or Ahafo Mahogany. These names are derived from the light coloured bark and the district of Ashanti where it is fairly common.

TRADE NAME. African Mahogany.

A large tree belonging to the emergent canopy. Details of trees felled in Sefwi are given below:

Girth above buttresses	Bole length	Height of tree	Volume over bark
13ft. 11in.	73ft. 9in.	174ft. 7in.	905 cu.ft.
15 10	73 6	187 1	1,056
17 3	108 9	186 9	1,144
19 8	53 9	179 8	1,141

The bole is straight and clear, and it is buttressed to 9 ft. or more. The crown is rounded and the branches are stout. The bark is light coloured, almost a silvery grey, and when it flakes off fewer pits are left than with K. ivorensis. The slash is red and scented but not as strongly as in K. ivorensis. A clear gum exudes from wounds. The pinkish heart darkens on exposure. It is about 41 lb. per cu. ft., air dry. The texture is slightly coarse and requires filling before polishing. It is moderately durable. In transverse section, small, scattered vessels are just visible. The fine and numerous medullary rays which are slightly redder than the wood can be seen with a hand lens. The wood is used in making furniture.

BOTANY. The leaves are alternate, paripinnate, exstipulate, and there are 2-4 pairs of opposite, glabrous leaflets. The leaflet is thin, elliptic, about 4 in. long and 2¼ in. broad, entire, broadly apiculate, almost rounded and unequal at the base, and with a slender petiolule about ½ in. long. The fine midrib and very fine nerves are raised below and the venation is reticulate. The small white flowers are paniculate and are usually tetramerous - 4 sepals, 4 petals, 8 anthers on a staminal tube, and a superior ovary of 4 loculi with many ovules. The fruit is a globose, erect, stalked capsule, about 3 in. diameter, and opening by 4 woody but thin valves. The seeds are golden brown, flat, irregularly shaped, about ½ in. long and 1 in. broad, and surrounded by a narrow, irregular, thin wing. They are packed one above the other on the four faces of a vertival columella.

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Khaya grandifoliola. 1.Tree. 2.Bole. 3.Fruit.

PHENOLOGY. The main period of lowering is from June to July and the ripe fruits are available from December to March. But there are individuals which flower and fruit out of season.

DISTRIBUTION & SILVICULTURE. The approximate extent of this species in the Gold Coast is an area bounded by latitude 6°10'N. to 7°15N. and from 1°20'W. to the western frontier. Aubreville states that K. anthotheca requires more light than K. ivorensis and also its growth is more rapid at the start.

The following frequencies are from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Bia South	734	33	17	19	9	4
Asenanyo	77	3	1	-	1	-
Ayum	306	15	11	7	11	6
Asukese	647	32	8	12	9	6
Bonkoni	167	14	7	5	6	8

(ii) Khaya grandifoliola C.DC.

SYNONYMS. K. grandis Stapf K. kissiensis A.Chev. K. punchii Stapf

VERNACULAR NAMES. Kruba (Ash,T). Odupon (Ash,T).

TRADE NAME. African Mahogany.

A tall emergent tree, up to about 150 ft. high, but usually not as straight as K. ivorensis. The bole is often leaning and sometimes twisted. The buttresses may be about 9 ft. high or more, and are narrow. The crown is rounded, often deep and spreading, and is conspicuous with its drooping shiny leaves. The bark is dark brown, thick, and scales off in circular discs which leave shallow depressions. The slash is red, turning brown on exposure, and has a bitter taste. A clear gum exudes slowly from wounds. The heart darkens from pink to brown. It is harder and heavier than that of K. ivorensis and often has a twisted grain. In transverse section, many small vessels are visible. With a hand lens, a small ring of parenchyma can be seen around the vessels, and the numerous medullary rays are slightly redder than the wood. The wood is used for local furniture sometimes, but is not liked by the Timber Trade.

BOTANY. The leaves are alternate, glabrous, paripinnate, consisting of about 3-5 pairs of opposite or sub-opposite leaflets, and exstipulate. The leaflet is elliptic, elliptic to oblong-elliptic, about 6½ in. long and 2¾ in. broad, entire, with a short acumen and broadly cuneate at the base. The slender petiolule is about ½ in. long. The midrib is raised below and the nerves

are very fine. The profuse, small, scented, creamy-white flowers are in terminal panicles and are pentamerous. There are 5 sepals, 5 petals, 10 anthers on a staminal tube, and a superior ovary of 5 loculi with many ovules. The fruit is a globose, woody capsule, about ¾ in. diameter, and stalked. There are 5 valves which are about 0.4 in. thick - the thickest of the High Forest Khayas. The thin, light brown seed are similar to those of K. ivorensis.

PHENOLOGY. Some trees are deciduous for short periods from November to January, but the flush of new leaves soon appears, and with it come the flowers. The principal flowering season is from January to March. The ripe fruits are available from October to March, and they are very conspicuous standing out from the crown of the tree. They open on the tree and the seeds are wind distributed. Unless in a storm, seed dispersal is not far, as the wings are rather ineffective.

DISTRIBUTION & SILVICULTURE. K. grandifoliola has its greatest frequency in the Antiaris-Chlorophora Association, particularly on high land. It is common along the Mampong (Ashanti), Ejura and Kwahu Scarps, north of Begoro and in the Togoland hills. It is also found in the Riverain Forest of the southern Guinea Savannah-Woodland, and as a relic in the Derived Savannah-Woodland of Northern Ashanti and Togoland. This species also occurs on Bosumtwi Range in the Celtis-Triplochiton Association. In 1908, H.N.Thompson (43) observed "almost pure patches on Lake Bosumtwi hills". K. grandifoliola is a light demander, although it requires a certain amount of overhead shade in early youth. Often it is found in small groups. It is a dominant.

Enumeration surveys give the follwing frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Northern Scarp East	352	6	4	4	6	2
" " West	577	79	60	38	44	17
Worobong	278	8	8	6	7	5
Boumfum	154	6	4	3	4	4

SEEDLING. Germination is hypogeal. The shoot is red and slender and the first two leaves, which are opposite, are borne about 3 in. above ground. The succeding leaves are alternate. The 3rd. leaf is simple, oblong-elliptic, about 3 in. long and 1¼ in. broad, entire, acuminate (but not so markedly as K. ivorensis), broadly cuneate, glabrous, light green and thin, with a short petiole and exstipulate. Paripinnate leaves develop later.

ARTIFICIAL REGENERATION. There are about 120 winged seeds to an ounce. They do not retain their viability for very long and should be sown when fresh. The germination period is about 19 days, and with fresh seed, about 85% should germinate. Screens over the nursery beds are desirable in sunny weather. In one sample, a plant percentage of 74 was obtained at the end of 15 months, when the plants were 3 ft. 6 in. high. Sapling height growth is quite rapid and an annual increment of 15 in. or more is normal. Although a light demander once it has passed the seedling stage, it suffers from the shoot borer (Hypsiphyla) if given too much overhead light. The crown is small, although larger than that of K. ivorensis, and does not form a closed canopy in young plantations where the planting distance is 10ft. X 10ft.

(iii) Khaya ivorensis A.Chev.

SYNONYMS. K. caudata Stapf ex Hütch.&Dalz. K. klainei Pierre ex A.Chev.

VERNACULAR NAMES. Dubini (Ao,Ash,F,S,T,W). Odupon (Ash,T). The second name is derived from the Twi for great or large tree.

TRADE NAME. African Mahogany

A large tree and an important one because of its value as a timber. Until recent years, most of the timber exported from the Gold Coast was this species. Measurements of felled trees are as follows:

Girth above buttresses	Bole length	Height of tree	Volume over bark
15ft. 1in.	80ft. 9in.	171ft. 10in.	837 cu.ft.
16 6	78 0	164 6	1,396
17 5	73 0	196 4	1,048
18 1	60 10	175 2	1,077
23 11	51 11	136 8	938

The bole is tall and cylindrical. High, winged buttresses are formed, which are rather characteristic as usually one is more developed than the others. In fact, one side of the bole may appear as if the tree were not buttressed. The crown is rounded and the spreading branches are inclined upwards. The crown is dense and dark but thins out in the old trees. The bark is thick, brown and distinctly pitted by shallow "shot hole" depressions due to scales flaking off in discs. The slash is red with a pink underlayer; it is scented and bitter to the taste. There is a delayed exudation of a pale gum from wounds. The pink heart darkens to brown on exposure. It is almost 35 lb. per cu. ft. at 15% moisture content, has good working

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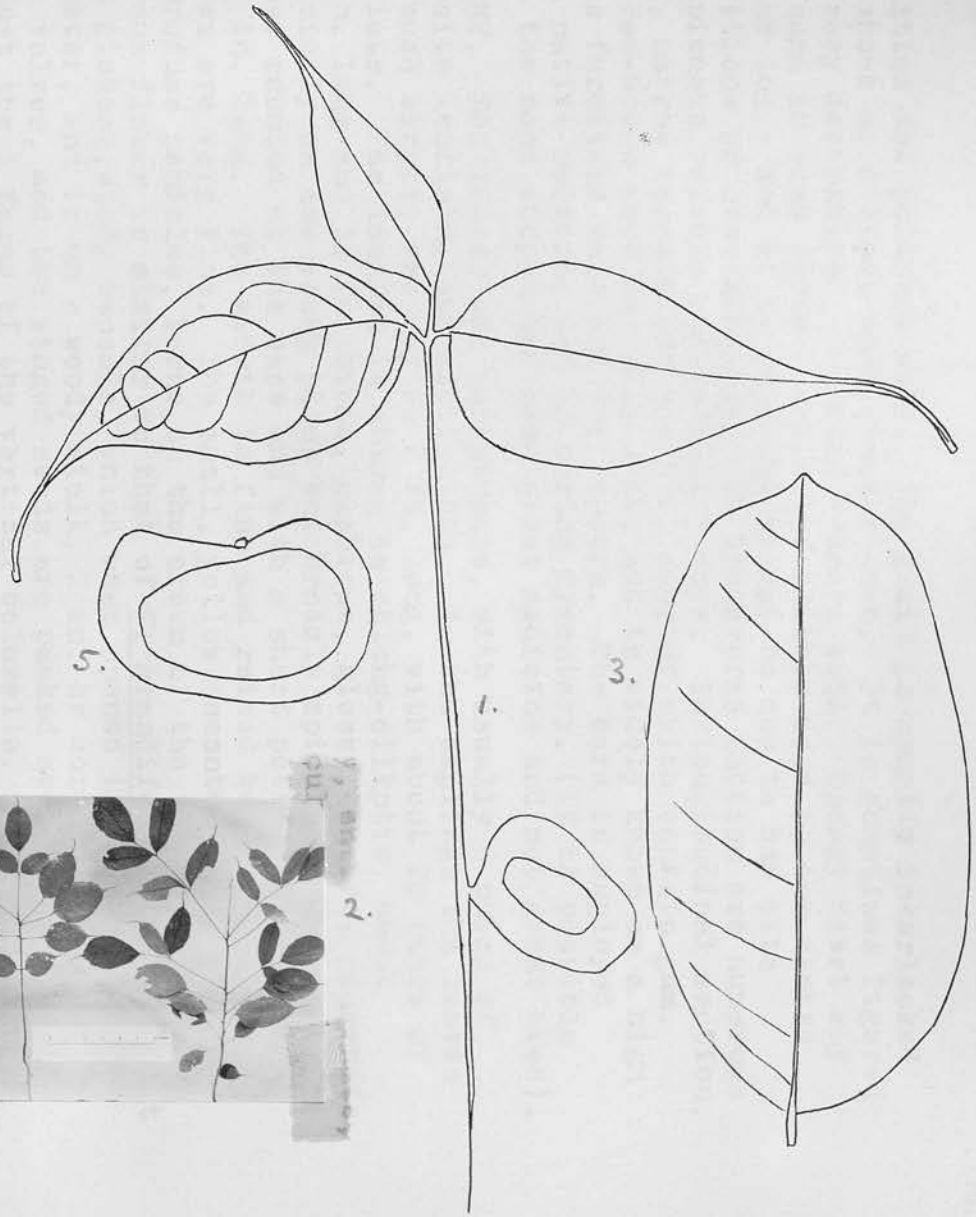

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Khaya ivorensis. 1.Seedling x 1.
2.Seedlings. 3.Leaflet x 1.
4.Sapling leaf. 5.Seed x 1.

qualities and polishes well. The grain is usually interlocked and shows as stripes when quarter sawn. It is sometimes figured and very decorative. The wood veneers well. Spongy heart may be found in some trees - a zone of brittle wood in the centre of the log - and it is possible it may be due to bad site conditions or over-maturity. In transverse section are numerous conspicuous vessels and medullary rays. In longitudinal section, long, narrow vessels are visible, many of which contain gum. The red-brown wood has many uses, and is widely known as a high class furniture wood and for veneers. The bark is employed as a native medicine and in curing dysentery. (It is possible that the name odupon may mean great medicine and not great tree).

BOTANY. The leaves are paripinnate, with usually 6 pairs of opposite leaflets, and exstipulate. In the saplings the leaves are much bigger, and may be 2 ft. long, with about 20 pairs of leaflets. The leaflet is oblong to oblong-elliptic, about $3\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad, glabrous, glossy, entire, acuminate, especially on the young plant but broadly apiculate on old ones, almost rounded at the base and with a short petiolule about 0.15 in. long. The midrib is fine and raised below, and the nerves are very fine. The small, yellow, scented flowers are in profuse panicles, borne on the crown of the tree. The pentamerous flower is similar to that of K. grandifoliola. The fruit is a globose, woody capsule, which when opened is about 5 in. diameter, and is on a woody stalk, 2 in. or more long. It opens by 5 valves, and the winged seeds are packed above each other against the 5 faces of the vertical columella. The brown seed is flat, irregularly oblonb to triangular in shape depending on its place against the columella, about $\frac{3}{4}$ in. long and $1\frac{1}{4}$ in. broad and surrounded by a narrow wing.

PHENOLOGY. K. ivorensis obtains a new crown of leaves usually between September and November, but the fresh leaves may begin to appear before the old ones fall. If the harmattan is early and severe, then there may be a short leafless period for some of the trees. The flowering season is July to January, with most of the trees in flower between September and December. Fruits soon make their appearance, and are conspicuous, as they stick out from the crown of the tree. They are ripe and open from February to May. The seeds are wind distributed, but do not travel far from the mother trees. The empty capsules may remain on the trees for some months.

DISTRIBUTION & SILVICULTURE. K. ivorensis is found throughout the High Forest Zone except where K. grandifoliola occurs, although the two species may intermingle along their common frontier. It prefers heavy or rich alluvial soil near water courses and damp areas, but must have good drainage. It is thus found near water, but not in it. Because of its site preference its distribution is very uneven. Itiis never frequent and in

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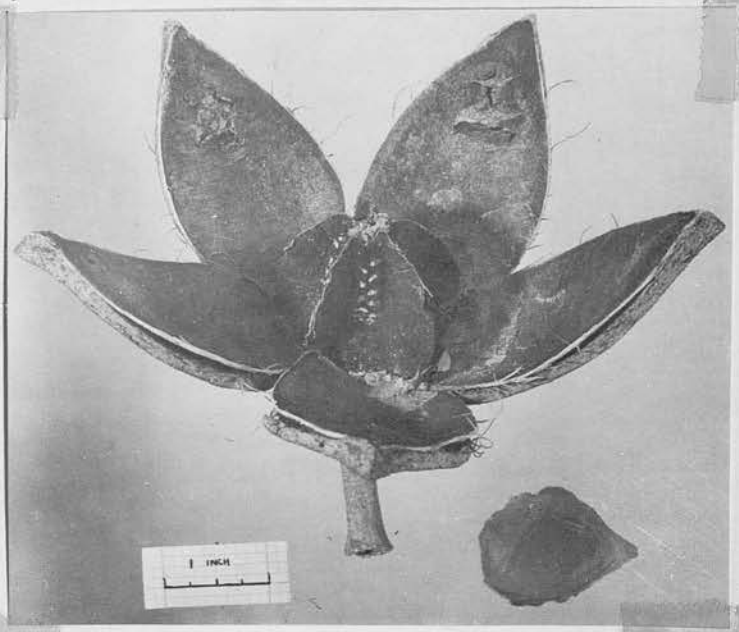

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Khaya ivorensis. 1.Tree. 2.Bole.
3.Fruit & seed. 4.Plantation crop
4 years old.

parts of the Rain Forest it is scarce. This may be partly explained by the amount of mahogany exploitation that has taken place in this area, and which began some 60 years ago. K. ivorensis is a light demander, but not at first. It requires a certain amount of shade during its first two years; in the sapling and young pole stages it does best if not exposed to too much overhead light. It is very susceptible to shoot borer attack (Hypsiphyla) if subjected to open conditions when young.

Frequency figures are given by the following enumeration survey results:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Subri	965	74	45	44	28	26
Fure	381	17	16	31	16	9
Yoyo	569	34	16	16	9	38
Kakum	508	25	24	30	24	16
Oda River	436	127	30	36	29	40
Bobiri	94	17	5	8	5	20

SEEDLING. Germination is hypogeal and the cotyledons remain within the seed coat. The shoot is red and slender. The first two leaves are opposite and are borne about 4 in. above ground. Later leaves are alternate. The 3rd. leaf is simple, ovate, about 3 in. long and 1 in. broad, entire, thin, with a long, narrow acuminate tip, a rounded base and a short, slender petiole. All parts of the seedling are glabrous. Paripinnate leaves are developed during the first month if light conditions are adequate.

NATURAL REGENERATION. Although this may be locally common soon after seed-fall, there is a high mortality among the seedlings. The seedlings are partial shade bearers but require more light than do the Entandrophragmas. This is not always available to them in the normal forest. Where the canopy is opened gradually, as in the Tropical Shelterwood System, K. ivorensis seedlings and saplings grow well, especially on slopes near water courses. Regeneration of this species in Secondary Forest is unusual.

The following seedling heights have been recorded in Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
9in.	18in.	33in.	42in.
9	13	28	43
8	12	14	20
14	16	42	53
12	18	21	26
7	29	31	42

ARTIFICIAL REGENERATION. There are about 60 seeds in a capsule. They vary in size a little from the larger oblong basal ones to the smaller triangular ones at the apex of the columella. One ounce contains about 150 winged seeds, but samples have given figures of 130-240. The seed does not remain viable for long and is also readily attacked by grubs on the ground. The germination period is 8-21 days, and although 80% of the seeds should germinate, nursery results are more often about 60%. The seedlings need to be shaded lightly. Growth is a little irregular, and the seedlings vary from 5-16 in. in height in 6 months, and up to about 2ft. 10in. in the first year. Nursery stock 15-18 months old and 3-5 ft. high is suitable for plantation work. Stripped plants have given good establishment results. K. ivorensis is not really a suitable plantation crop as the open conditions cause it to become a prey to the Hypsiphyla moth. The larvae bore the leading shoot throughout its length, and when it dies, the dormant buds at the base of the current shoot develop. Two or more leaders may be formed. Because of this, growth in plantations is uneven. The crowns of K. ivorensis up to and including the pole stage are very small and do not form a closed canopy where the planting espacement is 10ft. X 10ft. or more. Four years after planting in the 1947 Taungya in the Bobiri F.R., K. ivorensis saplings had reached a height of 16 ft. and 5 in. G.B.H., where they were on the lower slopes, towards water. The saplings were about 3 ft. high at the time of planting.

PATHOLOGY. Hypsiphyla attack has been noted above, where the seedlings and saplings are growing in more or less exposed conditions. Seldom does this attack take place where there is a canopy over the plants.

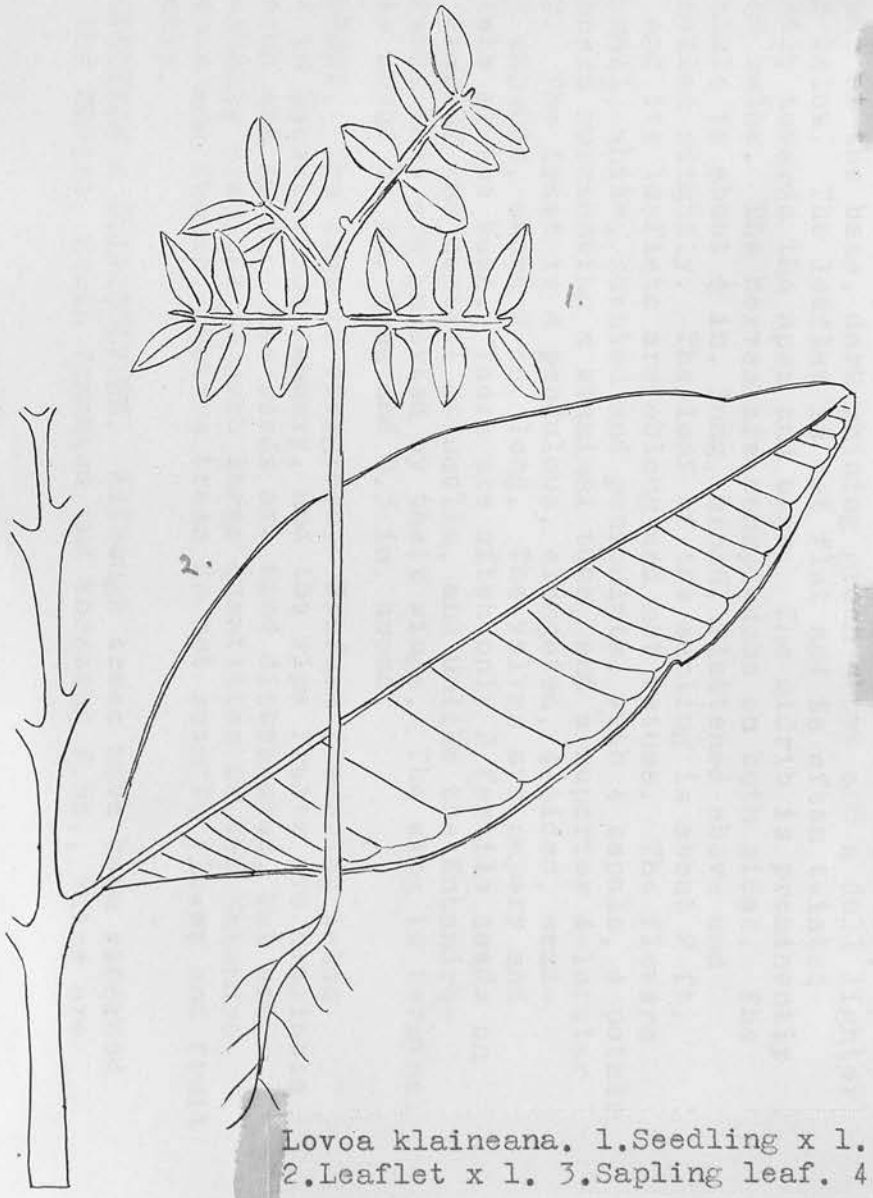
Leaf galls are a common occurrence especially in the seedling and sapling stages where plants are exposed to much light. They do not seem to cause any real damage, but must result in some lessening of photosynthesis.

4. LOVOA Harms

Lovoa klaineana Pierre

VERNACULAR NAMES. Akwantanuro (Ash,F). Dubinibiri (Ash,W). Fuga (Ash). Mpengwa (Ao). Pepedom (Nz,W). Timabiri (W).
Dubinibiri and Timabiri mean black mahogany (Khaya) and black Entandrophragma cylindricum respectively, and the names are derived from the dark bark and scented slash of Lovoa.

TRADE NAME. African Walnut.



Lovoa klaineana. 1.Seedling x 1.
2.Leaflet x 1. 3.Sapling leaf. 4.Bole.

A tree growing in the Tano-Anwia F.R. had an estimated height of 140 ft., of which about 90 ft. was clear bole. The girth B.H. was 18 ft. 9 in.. The bole of Lovoa is straight and cylindrical, and when buttresses do develop they are short. The crown is compact and not very dense, but tends to open out a bit when older. The smooth bark with its numerous lenticels darkens from grey to almost black. Old trees are scaly towards the base. The slash is thick, fibrous, red with white vertical streaks, and is highly scented. There is a gummy exudation from wounds. The sapwood is white and lustrous. The heart is golden brown, often with dark lines in it due to gum veins. It is this colour which gives the timber its trade name of African Walnut. The wood is about 35 lb. per cu. ft., seasoned, has an interlocked grain but works well, has a good sheen and takes on a high polish. It is listed as fire resistant by the London County Council. In transverse section, the small vessels are just visible. With a hand lens the very many vessels and numerous medullary rays can be seen. The principal uses of the timber are for cabinet work, veneers and panelling.

BOTANY. The leaves are alternate, glabrous, paripinnate, with about 4-6 pairs of opposite or sub-opposite leaflets, and exstipulate. The rhachis, about 5 in. long, is slightly winged. The leaflet is oblong-elliptic, about $5\frac{1}{2}$ in. long and 2 in. broad, entire, with a short, broad acumen which is often retuse, cuneate at the base, dark shining green above and a dull lighter green below. The leaflet is not flat and is often twisted slightly towards the apex and base. The midrib is prominently raised below. The nerves are conspicuous on both sides. The petiolule is about $\frac{1}{4}$ in. long, broad, flattened above and channelled slightly. The leaf of the sapling is about 2 ft. long and its leaflets are oblong and not retuse. The flowers are small, white, scented and paniculate, with 4 sepals, 4 petals, 8 anthers surmounting a staminal tube, and a superior 4-locular ovary. The fruit is a pendulous, elongated, 4-sided, semi-woody capsule, about 2 in. long. The valves are papery and separate at the base. There are often only 2 fertile seeds on each face of the central columella, and unlike the Entandrophragmas, they are inserted by their wings. The wing is terminal and is about $1\frac{1}{4}$ in. long and 0.3 in. broad.

PHENOLOGY. The tree is evergreen. Profuse flowering takes place in December and January, and the ripe fruits are available in March and April. The seeds are wind distributed, but are not usually produced in such large quantities as the Entandrophragmas and Khayas. Mature trees do not seem to flower and fruit annually.

DISTRIBUTION & SILVICULTURE. Although trees have been recorded from the Bobiri, South Fomangsu and Worobong F.Rs., these are

isolated cases of this species on the northern limits of its range. Optimum conditions for it appear to be in the region of Ateiku. The species extends into the Rain Forest. It is never frequent; it prefers well drained sites. In youth it is more shade tolerant than the Entandrophragmas and Khayas, but after this initial stage, it requires overhead light, and will grow quickly if conditions are suitable.

Enumeration survey results give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11--
Subri	965	25	9	3	3	-
Ndumfri	175	2	10	1	1	1
Fure	381	3	-	2	-	1
Atewa Range	573	8	15	11	4	-
Oda River	436	27	9	2	4	1

SEEDLING. Germination is epigeal. The hypocotyl is about 1½ in. long and the green cotyledons do not develop. The first two leaves are opposite and the rest alternate. All leaves are paripinnate and glabrous. The 3rd. leaf is about 1¼ in. long and consists of 3 pairs of opposite leaflets, which are oblong-elliptic, about ½ in. long and 0.3 in. broad, entire, obtuse, broadly cuneate and sessile or sub-sessile. The rhachis is markedly winged.

NATURAL REGENERATION. This is usually quite common in the seedling stage around the tree, and further away to the leeward side. The seedlings will survive for some time, but require overhead light for their development. Height growth may be only 6 in. in the first year, but in the sapling stage, under reasonable conditions, it increases to about 20 in. a year. The sapling is sturdy and not branched.

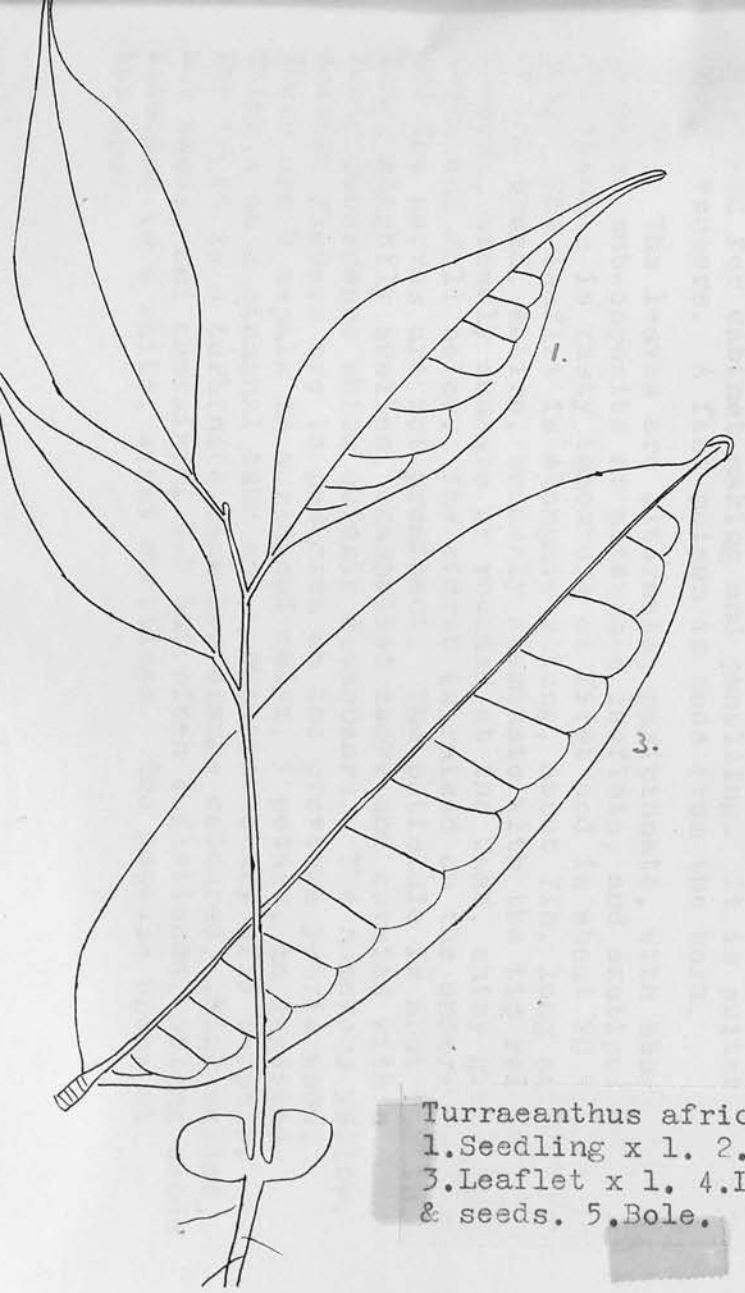
ARTIFICIAL REGENERATION. Lovoa is a favourite and successful plantation tree in the Ivory Coast, especially in line plantings to improve poor forest. It has not been used in the Gold Coast where little attempt has been made to collect the seed.

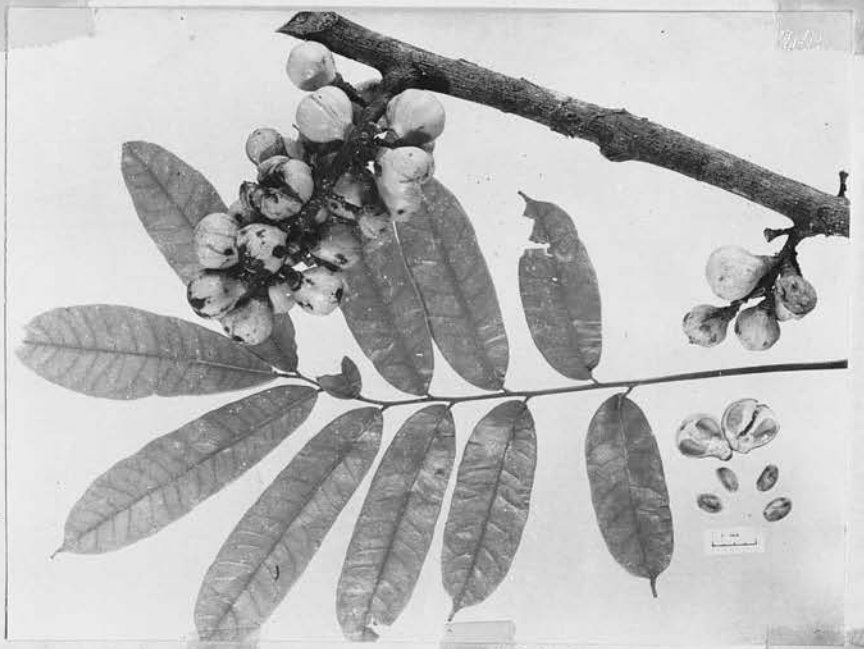
5. TURRAEANTHUS Baill.

Two Gold Coast species are listed (14)(20) - T. africana Pellegrin and T. vignei Hutch.& Dalz. It is doubtful if this is so and only T. africana will be considered here.

Turraeanthus africana Pellegrin

SYNONYMS. Bingeria africana A.Chev. Guarea africana Welw.





Turraeanthus africana.
1.Seedling x 1. 2.Seedlings.
3.Leaflet x 1. 4.Leaf, fruits
& seeds. 5.Bole.

VERNACULAR NAMES. Aniadwen (Nz). Apapaye (T,W). Gakrada (T). Oduma (Ash). Sunkroasu (S). Wansenwa (S). Wogya (Ash). Wonzanwa (Nz).

TRADE NAME. Avodire.

A medium sized tree which does not often go beyond 60 ft. high and 9 ft. G.B.H., but may be taller in some localities. Felled trees provide the following data:

Girth above buttresses	Bole length	Height of tree	Volume over bark
8ft. 3in.	41ft. 6in.	68ft. 2in.	173 cu.ft.
9 0	34 1	114 4	140
9 11	62 3	105 1	439
12 1	52 9	125 11	344

The bole is short and often forked at 30 ft. or less. There are no buttresses. The crown is large, deep, spreading, dark and shiny. The bark is light coloured and shell-like markings appear on the lower part of the bole of old trees. The slash is yellowish and scented. The wood is pale yellow, darkening to a golden yellow, lustrous, satiny, about 38 lb. per cu. ft. at 12% moisture content, not durable against decay, and liable to stain if not dried quickly. The interlocked grain gives a mottled figure which is seen to advantage when the log is quarter sawn. The wood works easily and finishes smoothly. In transverse section, the many small vessels are barely visible. Numerous fine medullary rays can be seen with a hand lens. The wood is in demand for cabinet making and panelling. It is suitable for sliced veneers. A fish poison is made from the bark.

BOTANY. The leaves are alternate, paripinnate, with about 10 pairs of sub-opposite or alternate leaflets, and exstipulate. The rhachis is rusty tomentose at first and is about 20 in. long. The leaflet is elongate oblong, about 7in. long and $1\frac{3}{4}$ in. broad, entire, suddenly acuminate with the tip rolled inwards, broadly cuneate or rounded at the base, shiny green above and dull below. The midrib is raised on the underside and the nerves are not prominent. The petiolule is abot 0.2 in. long, slightly swollen, channelled above and covered with a rusty pubescence which quickly disappears. The numerous yellow, scented flowers are in panicles on the previous year's wood. There are 5 sepals in a reduced calyx, 5 petals, 10 inserted anthers on a staminal tube and a superior ovary of 5 carpels. The fruit is a turbinate capsule, orange coloured, thick walled, not woody, and containing 1-5 but often 4 flattened, oblong seeds embedded in a white, sweet mucillage. The capsule opens at the apex.

PHENOLOGY. The tree is evergreen. Profuse flowering takes place between March and July, and fruits ripen from August to November. Trees of only 1 ft. 6 in. G.B.H. have been observed in the Pra-Anum F.R. to flower and produce fertile seed. Normally the capsules open on the trees and the seeds fall to the ground. Many are eaten there by duikers and other small animals and also quite a lot on the trees by birds. Native hunters take advantage of these feeding habits of the duikers. Seed dispersal appears to be very limited in extent.

DISTRIBUTION & SILVICULTURE. Turraeanthus is gregarious and localised. It belongs to the lower storey of the High Forest Zone, but has not been recorded from Togoland. Its distribution is very odd, and so far, it has not been correlated to climatic nor site factors. It occurs in groups and belts which do not appear to spread. Seldom is it seen as individuals, except south of Obuasi and south of Dunkwa, but these are almost certainly relic trees. Normally it does not occur in Secondary Forest. It is a shade bearer and is very liable to produce branches at an early stage and usually it is a tree with a poor habit. The size of the tree varies and the biggest are thought to occur in Sefwi and Adansi. Those in the Bobiri and Sothern Scarp F.Rs. are smaller and not attractive to the timber merchants.

The following frequencies are from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Subri	381	271	69	16	3	1
Pra-Suhien I	203	541	240	71	15	4
Atewa Range	573	534	233	69	22	8

SEEDLING. Germination is hypogeal. The cotyledons do not expand. The shoot is dullgreen at first and becomes light, dull brown at the base. There are many light, dull brown lenticels in vertical rows. The primary leaves are alternate. The 1st. leaf is simple, oblong-lanceolate, about 3 in. long and 1 in. broad, entire, with a long acuminate tip, cuneate at the base, dull green above and glabrous. The petiole is about 0.2 in. long, channelled above and rufous pubescent, and rounded below.

The following measurements of seedlings are taken from Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
9in.	20in.	30in.	52in.
8	12	24	60
8	10	33	51
11	34	42	84
9	20	30	57

NATURAL REGENERATION. This is plentiful under the mother trees and nearby, if there is adequate shade. In its 2nd. year the seedling can stand more light, and if it is available then height growth is greatly increased. Unfortunately, where there is more overhead light, branching is induced. A better shaped tree may be produced where the canopy is not too open.

ARTIFICIAL REGENERATION. The seed has a very short viability and must be sown fresh. There are about 25 seeds to an ounce. The germination period is usually about 36 days, although 15-18 days have been recorded. A plant percentage of about 85 should be obtained at 6 months (there are records of higher results) when the plants are about 6 in. high. In 1½ years they average 16-20 in. high, and are 3-5 ft. in 3 years. Light shade over the nursery beds is required.

MIMOSACEAE.

A family of trees and shrubs, with alternate, stipulate, compound leaves which are often bipinnate. There is frequently a gland at the base of the rhachis on the upper side and smaller ones towards the apex. The leaflet may be very small. The flowers are capitate or spicate, hermaphrodite, regular, usually small and pentamerous, with a reduced, tubular calyx and a superior, unilocular ovary. The fruit is a legume and in most cases is dehiscent.

This family is represented throughout the Gold Coast. In the Savannah-Woodland there are species of Acacia Willd. and Entada Adans., Parkia filicoidea Welw. and Prosopis africana Taub. Dichrostachys glomerata Hutch.& Dalz. is found in the Accra Plains, in the Coastal Scrub and as a riparian shrub or small tree in the Savannah-Woodland.

GENERA. 1. Albizzia Durazz. 2. Aubrevillea Pellegr. 3. Calpocalyx Harms 4. Cathormion Hassk. 5. Cylicodiscus Harms 6. Parkia R.Br. 7. Pentaclethra Bth. 8. Piptadenia Bth. 9. Tetrapleura Bth. 10. Xylia Bth.

1. ALBIZZIA Durazz.

In addition to the trees described below there are A. chevalieri Harms recorded from Navrongo in the Savannah-Woodland, and A. lebbek Benth., an exotic used in town planting in the Northern Territorities, Accra and other dry places.

SPECIES. (i) A. coriaria Welw. (ii) A ferruginea Bth. (iii) A. gummifera (Gmel.) C.A.Smith (iv) A. warneckii Harms (v) A. zygia Macbride

(i) Albizzia coriaria Welw.

SYNONYM. A. poissoni A.Chev.

A medium sizes tree of about 50 ft. high and 6 ft. girth, but one of the bigger trees where it occurs. The bole is short and slightly buttressed, and the crown is rounded and spreading. The bark is grey, rough and scaly. The slash is pink and the sapwood white. The heart is very dark brown and shows growth rings. In transverse section, the vessels are easily visible; they are surrounded by parenchyma which is elongated transversely. The medullary rays are just visible.

BOTANY. The leaves are alternate and bipinnate with about 4 pairs of opposite pinnae. The principal rhachis is about 5 in. long with a raised gland at the base and apex on the upper

side; the secondary rhachis is about 3 in. long. Both are slightly pubescent. There are 6-10 pairs of opposite leaflets to a pinna. The leaflet is oblobg, about 0.7 in. long and 0.25 in. broad, rounded at the apex and unequal sided at the base, slightly pubescent on the underside of the midrib, and sessile. The whitish-yellow capitate flowers are conspicuous by reason of the red stamens. The fruit is a flat, thin, brown pod, about 8 in. long and 1 in. broad and markedly apiculate. It contains from 4-10 seeds.

PHENOLOGY. The tree is deciduous in January, when it flowers, and the fruits are ripe in October-November.

DISTRIBUTION. A. coriaria is found in the transitional zone between the High Forest and Savannah-Woodland, e.g. in the Bosomoa F.R. in Northern Ashanti.

(ii) Albizzia ferruginea Bth.

VERNACULAR NAMES. Awiemfosamina (Ash,F,T). Ebosamina (Nz). The first name means "poor man's soap".

Not really a big tree, but in good High Forest it may attain 120 ft. in height and 9 ft. G.B.H. Felled trees give the following data:

Girth breast high	Length of bole	Height of tree.
7ft. 9in.	96ft 0in.	124ft. 0in.
8 4	70 6	126 7
12 1	86 5	126 5

The bole is straight and fairly slender; there are small, irregular buttresses. The crown tends to spread. The bark is brown, shaggy and scaly. Young bark is roughly fissured, light brown, soft and quite thick. The slash is very light brown flecked with reddish-brown marks. Ripple marks are prominent in the white sapwood. The heart is dark brown, about 36 lb. per cu. ft. at 13% moisture content, fairly coarse texture, soft , is easily worked and is durable. In transverse section, the vessels and their surrounding parenchyma are visible. The very fine medullary rays can be seen with a hand lens. The long vessels are conspicuous in longitudinal section. The Akan vernacular name is derived from the property the leaves possess of lathering slightly in water.

BOTANY. The leaves are alternate and bipinnate, with 4-6 pairs of opposite pinnae, and about 6 in. long and 4 in. broad. There is a raised gland on the upper side, near the base, of the principal rhachis and one or more towards the apex between the pinnae; and similarly on the secondary rhachis below the basal pair of leaflets and between the uppermost ones. The principal rhachis and the secondary rhachides are rusty pubescent and

5.

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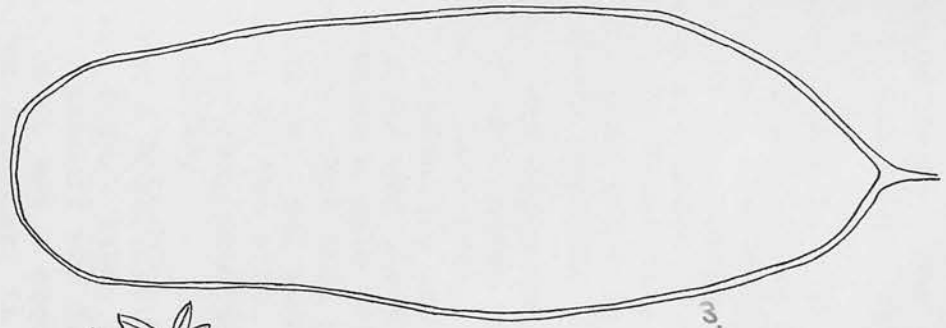

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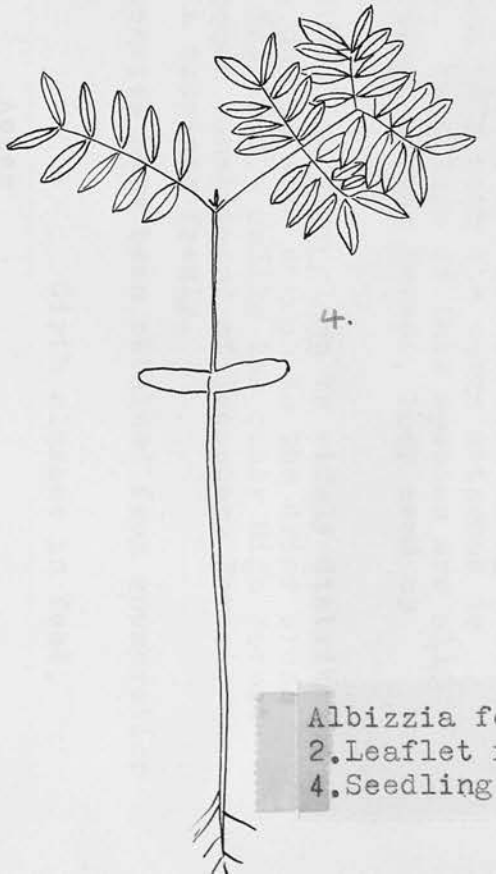

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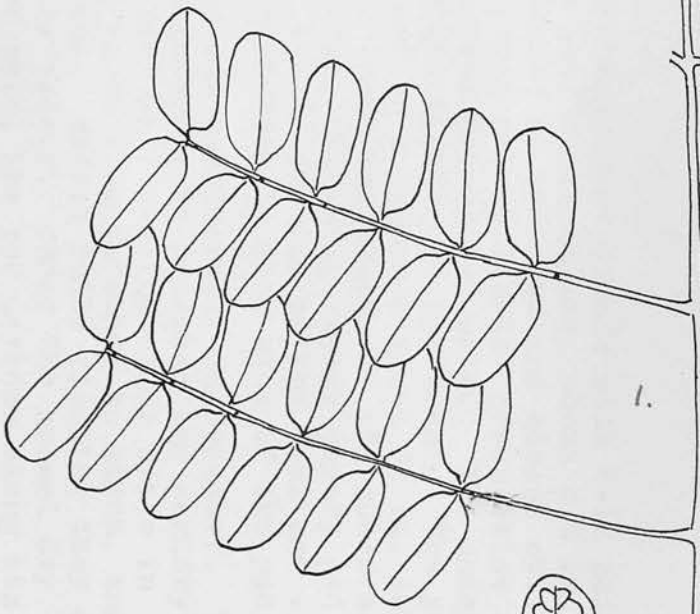


1.

2.

Albizzia ferruginea. 1.Pinnae x 1.
2.Leaflet x 1. 3.Pod x $\frac{1}{2}$.
4.Seedling.x 1. 5.Tree. 6.Bole.

have swollen bases. The pinna is paripinnate with 6-12 pairs of opposite leaflets. The leaflet is oblong, about 0.8 in. long and 0.4 in. broad, rounded at the apex and almost oblique at the base, entire, dark green above, lighter green below and sessile. The midrib and nerves are raised below. The underside of the leaflet, especially the midrib, is pubescent. The yellow inflorescence is capitate and on a peduncle about $3\frac{1}{2}$ in. long. The stamens are about three times the length of the pubescent perianth. The fruit is a flat, glabrous, rather papery pod, about 8 in. long and 2 in. broad, rounded at the apex and with about 10 seeds attached alternately to each side of the pod.

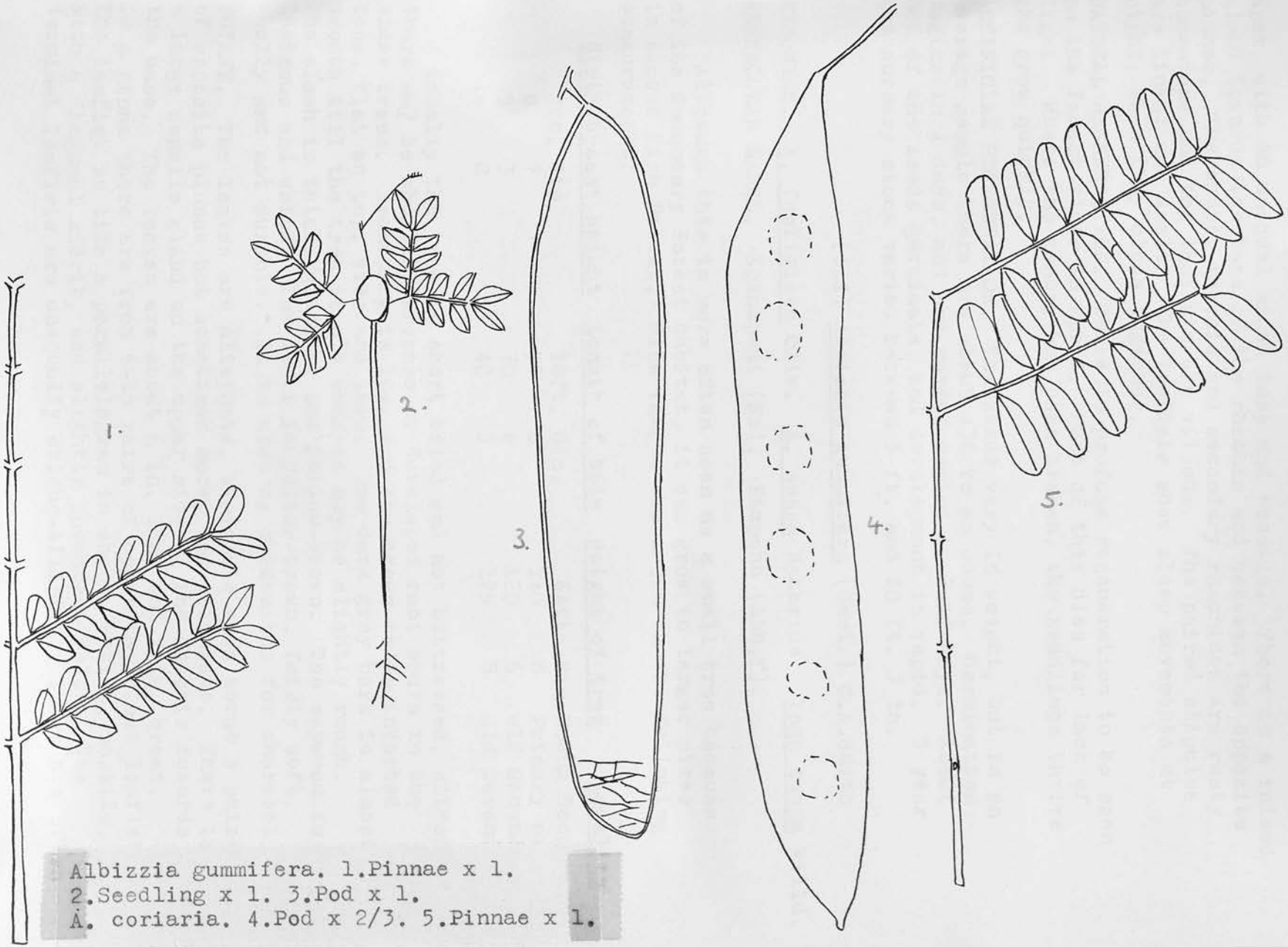
PHENOLOGY. The crown thins out considerably in December. The red flush of new leaves is apparent in December and January on the almost bare tree. Profuse flowering takes place in March. The pendulous pods ripen from November to March, and are conspicuous and plentiful. Before fully ripening they are red, but become a pale straw colour. Under the normal dry conditions for that time of year, the pod divides along its sutures into two, and each half with its seeds attached is carried away by the wind. When logs of this species are allowed to lie in the damp conditions of the forest, they send up epicormic shoots.

DISTRIBUTION & SILVICULTURE. A. ferruginea is widely distributed in the High Forest Zone, but is more common in the drier areas of Northern Ashanti and Togoland. Unlike the other High Forest Albizzias it is not a common constituent of Secondary Forest. Itis a light demander; it coppices freely.

The following frequencies have been obtained from enumeration surveys:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Subri	965	28	8	10	3	-
Bonkoni	170	4	4	2	-	3
Worobong	278	9	2	-	3	2
Bia Tano	262	4	2	3	-	1
Northern Scarp East	100	4	7	6	8	1

SEEDLING. Germination is epigeal. The hypocotyl is slender and about 2 in. long. The cotyledons are oblong, about $\frac{1}{2}$ in. long and 0.3 in. broad, rounded at the apex and sessile. The first leaf is borne about 1 in. above the cotyledons on a slender stem. It is paripinnate, anout 1 in. long and $\frac{3}{4}$ in. broad, and consisting of 5 pairs of opposite, sessile, oblong leaflets. The 2nd. leaf is opposite the first and is bipinnate, with 2 pairs of opposite pinnae. The leaflet is oblong, about $\frac{3}{4}$ in. long and nearly $\frac{1}{2}$ in. broad, rounded to obtuse at the



Albizzia gummifera. 1.Pinnae x 1.
2.Seedling x 1. 3.Pod x 1.
A. coriaria. 4.Pod x 2/3. 5.Pinnae x 1.

apex, with an unequal sided base and sessile. There is a raised gland towards the base of the rhachis and between the opposite pinnae. The shoot, rhachis and secondary rhachides are rusty tomentose and the leaflets are villous. The paired stipules are linear and small. The leaflets show sleep movements at night, when they close together.

NATURAL REGENERATION. There is profuse regeneration to be seen on the forest floor in April. Much of this dies for lack of light. Where the canopy has been broken, the seedlings thrive and grow quickly.

ARTIFICIAL REGENERATION. The seeds vary in weight, but in an average sample there are about 436 to an ounce. Germination begins in 4 days, and the normal period is 8-10 days. About 88% of the seeds germinate, and development is rapid. 5 year old nursery stock varied between 5 ft. and 10 ft. 3 in.

(iii) Albizzia gummifera (Gmel.) C.A.Smith

SYNONYMS. A. fastigiata Oliv. A. sassa Macbride. Inga sassa Willd.

VERNACULAR NAMES. Kpankpani (Nz). Pampena (Ash,T).

Although this is more often seen as a small tree because of its Secondary Forest habitat, it can grow to larger sizes in closed High Forest. Size ranges are shown in the following measurements:

Girth breast height	Length of bole	Height of tree	Locality.
3ft. 6in.	18ft. 8in.	64ft. 8in.	Young Secondary.
8 7	57 8	140 8	Primary or very
9 3	70 6	120 6	old Secondary.
14 8	40 3	129 8	Old Secondary.

Usually the tree is short boled and not buttressed, although there may be short buttresses or developed root spurs in the older trees. Branching is low, and the crown is an inverted cone, flat on top, wide and thin. The dark grey bark is almost smooth till the tree is old when it may be slightly rough. The slash is thick, granular and yellow-brown. The sapwood is lustrous and white. The heart is yellow-brown, fairly soft, woolly and not durable. It is used by goldsmiths for charcoal.

BOTANY. The leaves are alternate, bipinnate with about 6 pairs of opposite pinnae but sometimes more, and stipulate. There is a large sessile gland on the upper side of the rhachis towards the base. The leaves are about 6 in. long and 4 in. broad. On a pinna there are from 6-15 pairs of opposite, close leaflets. The leaflet is like a parallelogram in shape, entire, sessile, with a diagonal midrib, and slightly pubescent below. The terminal leaflets are unequally oblong-elliptic. There are often

small raised glands between the last two pairs of leaflets on the upper side of the secondary rhachis. The capitate inflorescences are conspicuous because of their long red stamens, about 3 times the length of the small, pubescent perianth. The pod is straw coloured, papery, pendulous, about 7½ in. long and 1 in. broad, and contains from 4-12 black seeds on long funicles. Fine veining is visible on the outside.

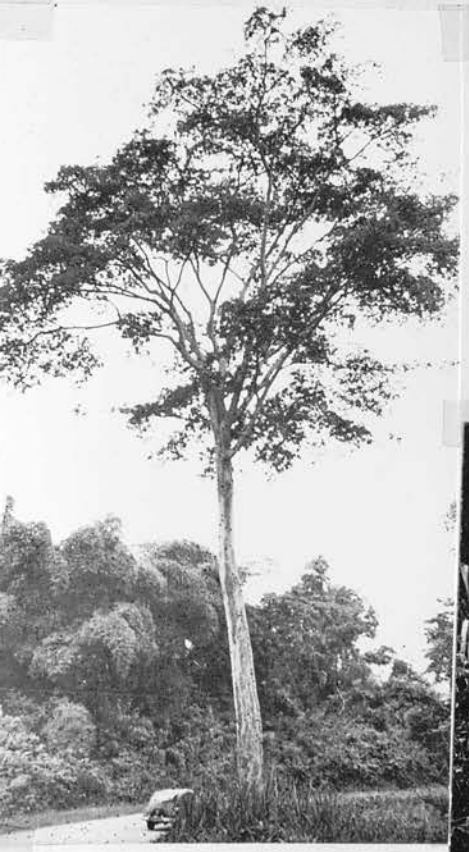
PHENOLOGY. From mid December to early March individual trees may be deciduous for short periods. Often the flush of new leaves appears before all the old ones have dropped. The conspicuous red flowers appear from mid February to April and cover the crown of the tree. The pods are prolific and are mature between November and March. Usually they open on the tree, and the light half pod with its seed is carried quite a long way with the wind. Dispersal is efficient.

DISTRIBUTION & SILVICULTURE. This is essentially a light demanding species of the Secondary Forest, where it is common. It is quick to colonise any gap and makes rapid progress in its early years. It soon spreads out to develop a large crown. In the disturbed forest of the western part of the Mpameso F.R. this species is frequent. It is common in old farms and soon grows above the tangled thicket. Its associates are A. warneckii and A. zygia.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Subri	965	28	8	10	3
Fure	381	7	12	3	-
Bia South	734	33	24	12	2
Bemu River	104	12	4	3	-
Worobong	278	26	16	2	2

SEEDLING. Germination is epigeal. The hypocotyl is very slender and about 1½ in. long. The cotyledons develop slightly and are almost square, about 0.3 in. long and 0.25 in. broad, with a rounded apex, auriculate at the base and sessile; they do not become foliaceous. The first two leaves are borne immediately above the cotyledons; they are bipinnate, each with i pair of pinnae and with a pair of linear stipules. There are 4 pairs of opposite leaflets on each pinna. The next leaves are alternate. The leaflet is like a parallelogram in shape, about 0.25 in. long and 0.1 in. broad, entire, sessile and with a diagonal midrib. The terminal leaflets are unequally oblong-elliptic. There is a raised gland just below the junction of



Albizzia warneckii. 1.Tree. 2.Bole. 6.Pinna x 1.7.Pod x 1.
A. zygia. 3.Seedling. 4.Pod. 5.Pinnae. All x 1.

the pinnae on the upper side of the rhachis. The hypocotyl, shoot and rhachis are lightly pubescent.

NATURAL REGENERATION. From March onwards, plentiful regeneration can be seen in any gaps in the High Forest Zone - in fact, almost anywhere in this Zone, unless grassed over areas in towns. It is not usually found in the denser parts of the forest. At first, full light is not required, but this condition is necessary for its proper development. Growth is rapid and a height of 3-5 ft. in a year is usual.

ARTIFICIAL REGENERATION. There are about 650 seeds to an ounce. The germination period is about 13-17 days, and about 90% of the seeds are viable. No screening is necessary in the nursery. In experimental sowings, heights at the end of a year were 3 ft. to 4 ft. 2 in. In 2 years some were 8 ft. high.

(iv) Albizzia warneckii Harms

This species is very similar to A. zygia, and in the field, the two are seldom separated, even by the natives. Points of difference are given below:

VERNACULAR NAMES. Kontole (S). Okuro-fitaa (T). But usually called Okuro, which is the Akan name for A. zygia.

The bark is almost whitish at times (this gives the tree the name of Okuro-fitaa which means the White Okuro) and slightly scaly and thin.

BOTANY. The leaflets are similar to those of A. zygia but have a small although distinct petiolule, and the gland towards the base of the principal rhachis is less prominent. The leaflet has a more rounded apex, is thinner and the underside is light blue-green.. The papery, light brown, smooth pod is longer, being about 8 in. long and 1 in. broad, and with more seeds - about 14.

(v) Albizzia zygia Macbride

SYNONYMS. A. brownei Oliv. Inga zygia DC.

VERNACULAR NAMES. Kulo (E). Kpule (Nz). Ohura (S). Okuro (Ash,F,T).

Usually a tree not much bigger than 100 ft. high and 8 ft. G.B.H. Larger specimens are sometimes found in closed High Forest - one in the Pra-Anum F.R. was 12 ft. 10 in. G.B.H. The following are measurements of some felled trees:

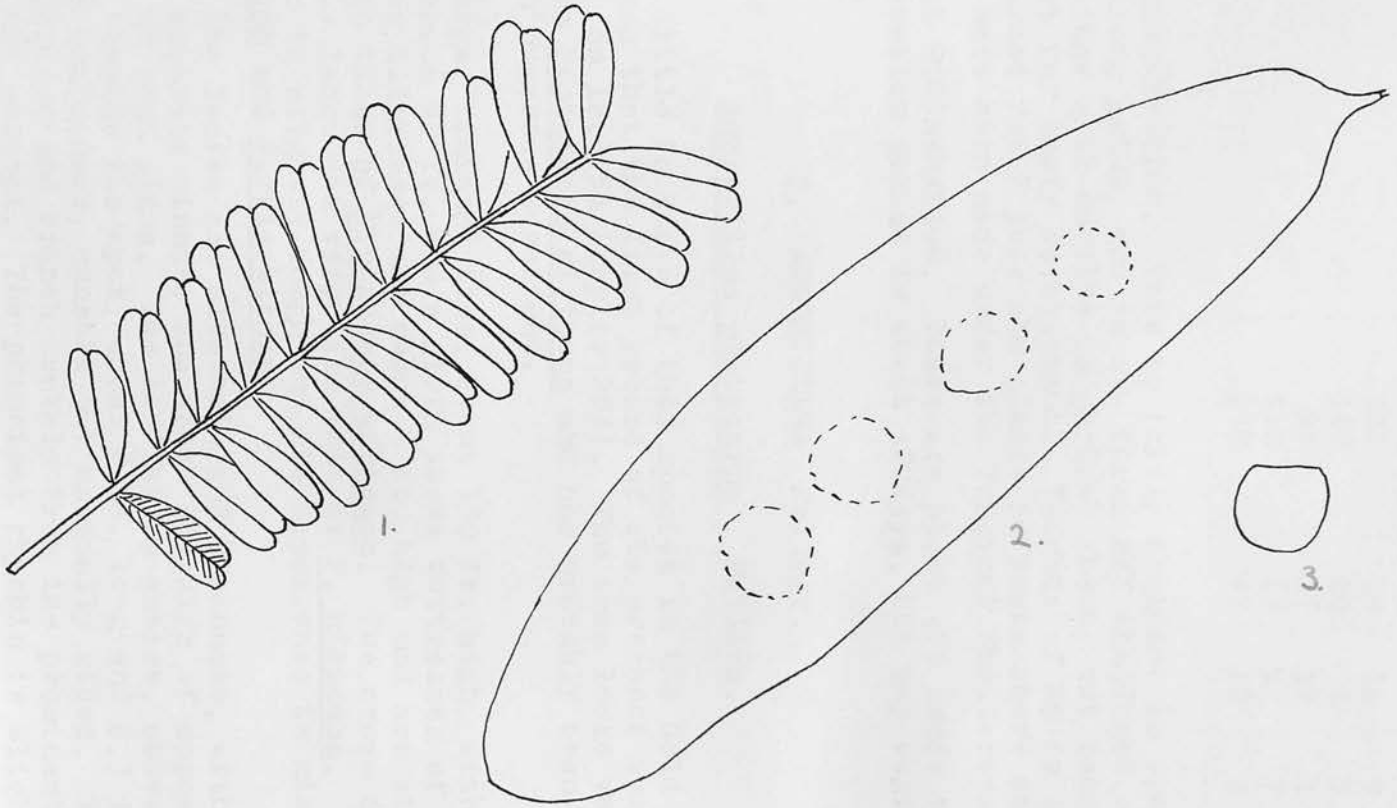
Girth breast height	Length of bole	Height of tree
6ft. 8in.	38ft. 7in.	88ft. 9in.
8 0	54 3	104 10
9 11	44 2	106 9
10 11	111 9	176 9

Often the bole is short, not very straight nor cylindrical. When buttresses develop they are small and are really root spurs. The crown has a tendency to form low down and spread. The bark is fairly smooth and mustard coloured to grey. The slash is fairly thick, granular, light yellow-brown, and with softer, almost vertical strands of fibrous tissue, lighter in colour, running through it. There is a delayed exudation of a dark brown gum from wounds. The sapwood is yellow-white. The heart is brown, about 32 lb. per cu. ft. air dry, fairly hard. moderately fine grained, works easily, polishes well and is not durable. Itis a popular charcoal wood around Kumasi.

BOTANY. The leaves are alternate, bipinnate, with 2-4 pairs of opposite pinnae, and stipulate. The upper pinnae are usually longer. There are 2-5 pairs of opposite, sessile leaflets on each pinna, and the terminal ones are the largest. The leaflets are entire, rhomboid, and vary in size from ½-2 in. long and ½-1½ in. broad. The apex is obtuse and the base is broadly cuneate and unequal. The midrib is not quite central and the lamina is green above and below. The rhachis, secondary rhachides and undersides of the midribs are slightly pubescent. The raised gland on the upper side of the lower part of the principal rhachis is prominent; there are smaller ones between some of the upper pinnae and leaflets. The axillary inflorescence is capitate and conspicuous because of the red filaments and styles. The pendulous pod is papery, straw coloured, elongate, about 6 in. long and 1 in. broad, and with a marginal raised rim. There are about 8 seeds.

PHENOLOGY. The old leaves are shed from August to March, and the tree may or may not be bare for a short period. The new leaves are conspicuous because of the bronze coloured flush. Flowering takes place from February to March, and the pods ripen between December and February. They usually open on the tree, and a large number of the seeds are wind distributed with the pods. The methos of dispersal appears to be effective.

DISTRIBUTION & SILVICULTURE. This species is widespread throughout the High Forest Zone, particularly in Secondary Forest where it is common along with A. gummifera and A. warneckii. It is also fairly common in good High Forest of the Celtis-Triplochiton and Antiaris-Chlorophora Associations, and is found in the Coastal Scrub and Grassland as a small tree. In fact, its distribution extends from the coast to the Riverain Forest of the southern Savannah-Woodland. It is a light demander and capable of rapid



Aubrevillea platycarpa. 1.Pinna. 2.Pod. 3.Seed. All x 1.

growth in its early life.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Fure	381	18	10	9	-	-
Birim	129	20	4	5	4	-
Asenanyo	96	17	12	1	-	-
Tinte Bepo	110	13	12	7	2	2
Wotobong	278	42	18	4	3	-

NATURAL REGENERATION. This is fairly abundant in openings in the forest, along paths, and in new farms and abandoned ones. The seedlings will survive in partial shade, but require overhead light for their development. Heights of up to 10 ft. have been recorded for 2 year old plants in areas where canopy openings have been made under the Tropical Shelterwood System.

ARTIFICIAL REGENERATION. There are about 456 seeds to an ounce. The germination period is about 12 days, but may begin on the 4th. day.

2. AUBREVILLEA Pellegr.

Aubrevillea platycarpa Pellerg.

Very little is known of this species in the Gold Coast as it seems that the first record of its presence was from the Yoyo F.R. on 12.1.51 (Taylor 284). The tree looks very similar to Piptadenia africana and has probably been mistaken for it on numerous occasions.

A large, dominant tree, about 130 ft. high, with a clear bole of about 90 ft. and a girth above buttresses of about 11 ft. The narrow buttresses are about 6 ft. high and are strikingly similar to those of Piptadenia africana. The crown is rounded and fairly large and very like that of P. africana. The bark is smooth to slightly rough and its appearance is midway between P. africana and Parkia bicolor.

BOTANY. The leaves are alternate and bipinnate, with about 5 pairs of opposite pinnae, and about 10 pairs of opposite, sessile leaflets on each pinna. The leaflet is entire, obovate-oblong, widening towards the apex, about $\frac{3}{4}$ in. long and 0.3 in. broad, obliquely emarginate, cuneate but unequally sided. The nerves are conspicuous and branch acutely from the prominent midrib which is not central. The principal rhachis is slightly pubescent, but there are no glands on it nor on the secondary rhachides.

The flowers are in yellow spicate inflorescences. The pod is elongate, about 5 in. long and 1¼ in. broad, papery, light straw coloured, indehiscent and containing up to 4 rather heart shaped seeds about ½ in. long and broad. Unlike Piptadenia the seeds are not winged.

PHENOLOGY. A flush of deep red leaves has been observed in December and the tree presented a pretty sight. In January the crown is covered with the spicate inflorescences and fruits are available in April and May.

DISTRIBUTION. This species has been found in the Yoyo F.R., at Mile 76 on the road from Wiawso to Jabeso, near Mim, and between Begoro and the Worobong F.R. Aubreville ( ) states that it "is spread throughout the 'deciduous forests' and more rarely in the 'rain forests'".

3. CALPOCALYX Harms

Calpocalyx brevibracteatus Harms

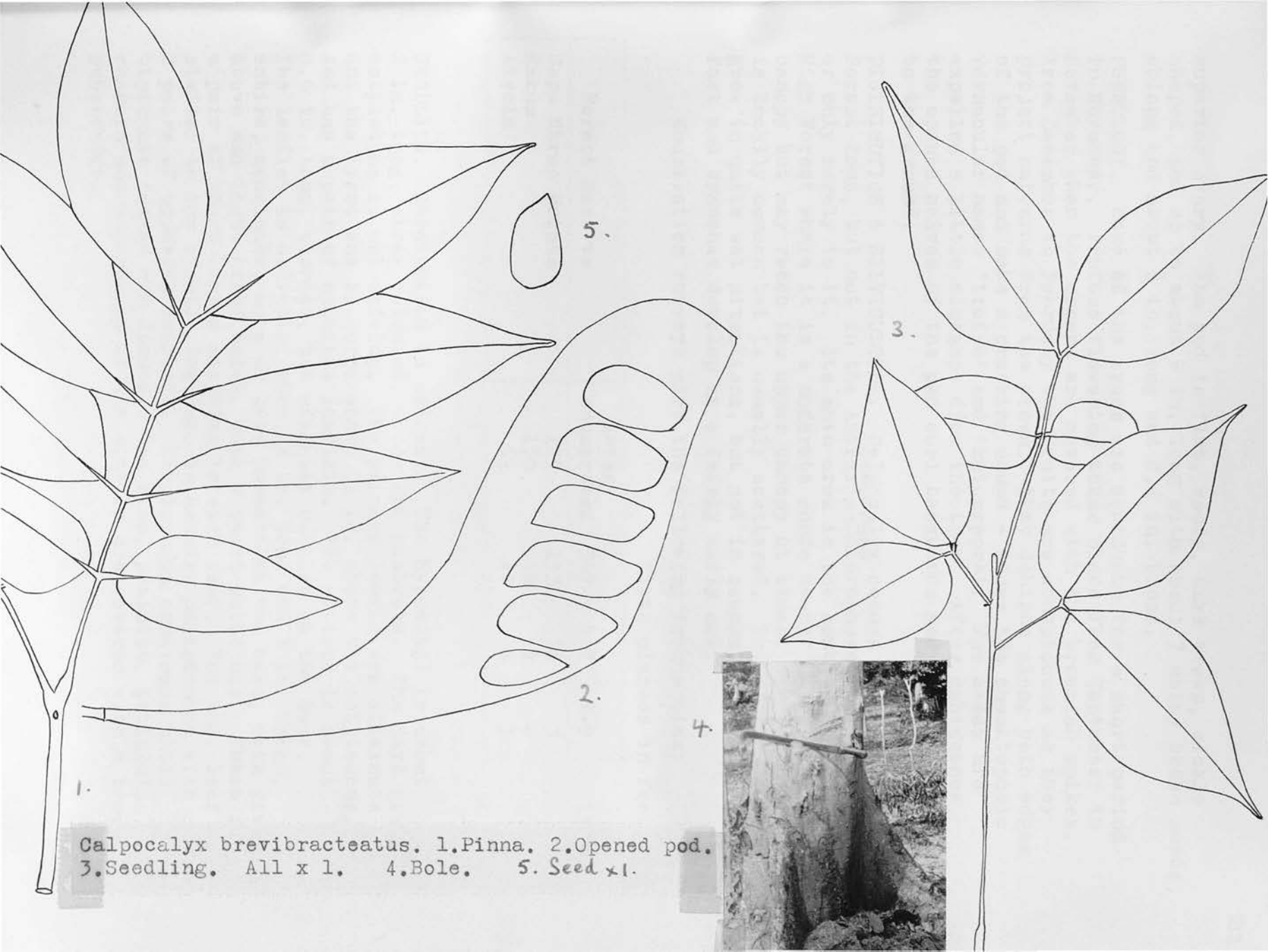
SYNONYM. C. macrostachys Harms

VERNACULAR NAMES. Apose (T). Kotoprepre (T,W). Samanta (T,W). Tretre (W).

Kotoprepre and Samanta are not specific as they are also applied to Berlinia, Bussea and Xylia - trees with large, woody, dehiscent pods.

A medium sized tree of about 70 ft. high and 5 ft. G.B.H., but often not as tall. The bole is fairly straight, with small buttresses. The habit is rather untidy as the branching is low and the crown of dark green foliage is dense and without a regular shape. The bark is smooth and brown. The slash is fairly thick, light brown, with white vertical lines. The white sapwood is quite hard. The heart is brown, heavy and hard. In transverse section, the vessels are barely visible; the parenchyma forms narrow transverse bands. A hand lens is required to see the fine medullary rays.

BOTANY. The leaves are alternate, glabrous, bipinnate, with 1 pair of opposite pinnae, and with caducous, linear stipules. The principal rhachis is about 1½ in. long, fairly stout and with a depressed gland on the upper side just below the junction of the two pinnae. The secondary rhachis is about 3 in. long, with about 4-6 pairs of opposite leaflets, and usually a gland between each pair on theupper side. The leaflet is oblong-elliptic, about 3 in. long and 1 in. broad, but variable as the lower ones are usually smaller. It is acuminate, with a cuneate or rounded base and a short petiolule. The flowers are small and arranged in brown spikes about 4 in. long. The perianth is pubescent and consists of a calyx tube shown by 5 teeth, and 5 petals, 10 stamens with quite long filaments and a unilocular



Calpocalyx brevibracteatus. 1.Pinna. 2.Opened pod.
3.Seedling. All x 1. 4.Bole. 5. Seed x1.

superior ovary. The pod is flat, woody, dark brown, sickle shaped, and up to about 9 in. long with about 7 shiny brown seeds, oblong and about ¾ in. long and 0.4 in. broad.

PHENOLOGY. Some of the trees are deciduous for a short period in November. Profuse flowering takes place from September to November when the crowns are covered with the brownish spikes. From December to February the fruits are conspicuous as they project outwards from the crown. They dehisce along both edges of the pod and make a cracking sound - hence the onomatopoeic vernacular names 'tretre' and 'kotoprepre'. The seeds are expelled a little distance from the tree. After dehiscence, the opened halves of the pod curl backwards and eventually fall to the ground.

DISTRIBUTION & SILVICULTURE. Calpocalyx occurs in the High Forest Zone, but not in the Antiaris-Chlorophora Association, or only rarely in it. Its main area is the southern half of the High Forest where it is a moderate shade bearer of the lower canopy but may reach the upper canopy at times. Sometimes it is locally common but is usually scattered. This species will grow in quite wet situations, but not in swamps. Growth is not fast and branches develop at a fairly early age.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9
Cape Three Points	129	133	34	3
Kakum	150	15	9	-
Aiyola	61	47	6	1

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long, straw coloured, woody and glabrous. The dark green cotyledons do not develop. The primary leaves are alternate and the first one is borne about 2½ in. above the cotyledons, and has a pair of opposite leaflets. The petiole is about 0.6 in. long, slender, but slightly swollen at the base. The leaflet is elliptic, about 2 in. long and 1 in. broad, entire, acuminate, more or less rounded at the base, dark green above and light green below, with a short petiolule. There is a pair of short linear stipules to each leaf. The 2nd. leaf is similar to the first. The 3rd. is usually paripinnate with 2 pairs of opposite leaflets. Development continues until bipinnate leaves are formed. The stem, petioles, petiolules, rhachis and undersides of the midribs are covered with a brown pubescence.

4. CATHORMION Hassk.

SPECIES. (i) C. altissimum Hutch.& Dalz. (ii) C. dinklagei Hutch. & Dalz.

(i) Cathormion altissimum Hutch.& Dalz.

SYNONYMS. Albizzia altissima Hook.f. A. passargei Harms
Pithecolobium altissimum Oliv.

VERNACULAR NAMES. Abobonkahyire (Ash). Angumeatee (Ao). Emerihili (Nz). Osron (Ash).

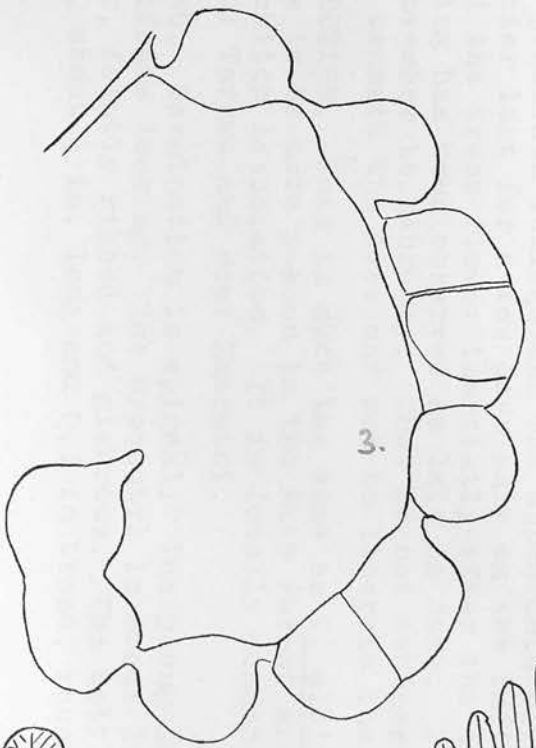
The first name means "it has formed head pads", being descriptive of the shape of the pod resembling a carrier's head pad.

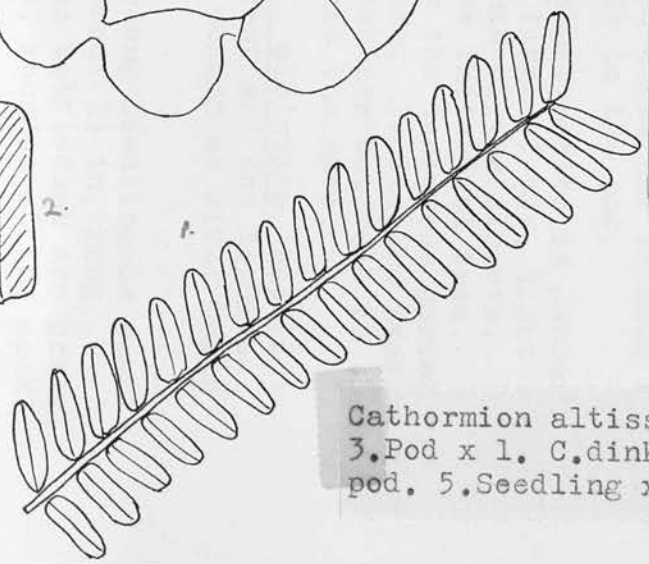
A small tree, usually not bigger than 40 ft. high and 4 ft. G.B.H., and of poor shape. The bole is short, not straight and branched low. There are usually short, irregular spines on the stem. The crown is low and spreading. The bark is light brown, thin and flaky. The slash is white with a yellow tinge and the sapwood is white and hard.

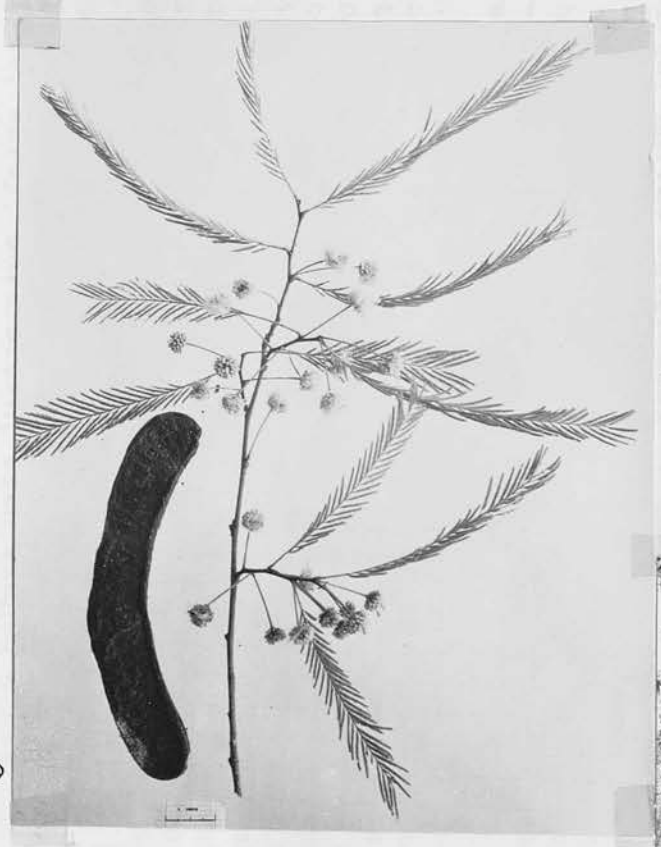
BOTANY. The leaves are alternate and bipinnate with about 7 pairs of opposite pinnae. There is a gland towards the base of the rhachis on the upper side, and 1-3 between the uppermost pinnae. The secondary rhachis is 3-4 in. long, and attached to it are about 15 pairs of opposite, sessile leaflets, which do not touch each other. The leaflet is narrowly oblong, about 0.6 in. long and 0.15 in. broad, entire, rounded at the apex, with an oblique base and glabrous.There is a rufous pubescence on the rhachis and secondary rhachides. The white, fragrant axillary inflorescences are capitate. The perianth of the small flower consists of a tubular calyx of 5 sepals, and a tubular corolla of 5 petals. There are about 15 stamens, but the number is not constant. They are exserted. The superior ovary is unilocular and contains many ovules. The fruit is a pod about 7 in. long and ½ in. broad, dark purplish-brown, curled, with about 16 seeds, and constricted between them. The seed is almost orbicular, about 0.3 in. diameter, light brown, and with the plumule and radicle visible through the testa.

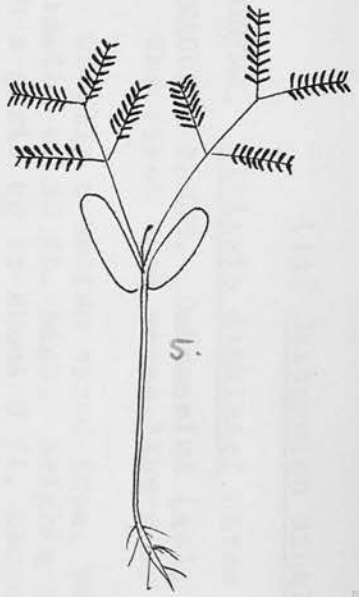
PHENOLOGY. Flowering takes place in September and October, and fruits ripen from November to January. The pods remain on the tree for a long time; when they break up it is often into 1-seeded portions.

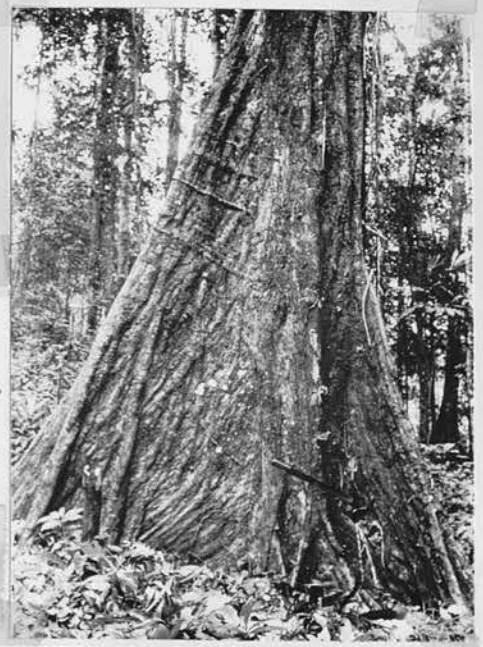
DISTRIBUTION. This species is found throughout the High Forest Zone and in the Riverain Forest of the southern Savannah-Woodland. It is essentially a riparian tree, although also found away from river banks. It has been recorded from such distant places as the Fuller Falls in Northern Ashanti, Esuasɔ, south of Tarkwa and at the foot of Togo Plateau F.R. - in each case as a riverside tree.











Cathormion altissimum. 1.Pinna.x 1. 2.Leaflet x 2. 3.Pod x 1. C.dinklagei. 4.Flowering branchlet & pod. 5.Seedling x 1. 6.Bole.

(ii) Cathormion dinklagei Hutch.& Dalz.

SYNONYMS. Albizzia dinklagei Harms Mimosa dinklagei Harms

VERNACULAR NAMES. Dahomanini (Ao). Fetefre (Ash).
The first name means "the male dahoma" (Piptadenia africana).

Usually a medium sized tree, but one in the Subri F.R. is estimated at 90 ft. high. Heights of 30-60 ft. are more normal, with a girth up to about 8 ft. above the buttresses. The stem is not straight and is fluted and twisted, and when old it may have close, narrow buttresses up to 12 ft. high. Often the smaller trees are not buttressed. The crown is low, heavily branched, drooping, spreading and light. The bark is dull, grey-brown, with thin scales and shaggy. The slash is fairly thin and yellow-brown. The sapwood is brown and appears to have a coarse texture.

BOTANY. The alternate leaves are bipinnate, with about 40 pairs of opposite pinnae, and 7 in. or more in length. Immediately above the thickened base of the principal rhachis is a raised gland on the upper side, and more between the dozen or so pairs of apical pinnae. There are about 40 pairs of opposite leaflets on a pinna. The leaflet is the smallest of all the trees on the Gold Coast. It is linear, about 0.1 in. long and entire. The midrib is not visible to the naked eye. The leaflet margin is ciliate and the rhachis is covered with a red pubescence. The flowers are in axillary, capitate inflorescences, which appear yellow because of the exserted stamens. The pod differs from that of C. altissima in that it is almost straight, being but slightly curved, and not constricted. It is about 6 in. long, hard, flat, warty, dark brown, with ridged edges and rounded at both ends. There are about 25 small seeds to the pod.

PHENOLOGY. The tree is deciduous for a short period in January or February, and this is followed by the flush of new, light green, pendulous foliage and the appearance of the flowers. The latter last for a few days only on the individual tree. Not all the trees flower immediatly after the deciduous period. Flowering has been observed as late as June. Fruits are available from November to February. They do not dehisce but fall to the ground beneath the tree and rot to liberate the seed.

DISTRIBUTION. This is much the same as C. altissima, but it appears to be more common in the Rain Forest and the Lophira-Triplochiton Association. It is locally common on river banks south of Tarkwa and near Samreboi.

SEEDLING. Germination is epigeal. The young seedling is small and delicate looking. The hypocotyl is about $1\frac{1}{2}$ in. long, slender, faintly ribbed and glabrous. The cotyledons are green, oblong, about $\frac{1}{2}$ in. long and 0.3 in broad, rounded at the apex

auriculate at the base and sessile. They do not expand and are unable to open out at right angles to the hypocotyl because they are attached at one-quarter of their length from the bottom. So the bases touch each other when the cotyledons have moved about 30°. The first two leaves are opposite and bipinnate, with 2 pairs of opposite pinnae to each leaf and about 10 pairs of minute leaflets to each pinna. There is a small but prominent raised gland on the upper side of the rhachis at the junction of each pair of pinnae. The succeeding leaves are alternate. All are stipulate - the paired stipules being short, linear and green. The principal rhachis and secondary rhachides are covered with a very delicate sparse rufous pubescence.

ARTIFICIAL REGENERATION. There are about 336 seeds to an ounce. Test sowings have given germination periods varying from 67-89 days.

FIELD NOTES. The young seedling may be confused with that of Acacia pennata Willd., a very common prickly climber, and Piptadenia africana. The latter has no raised glands. The gland on A. pennata is towards the base of the rhachis on the upper side and not between the pinnae. The normal diagnostic feature of the prickles is not evident of the very young seedling of A. pennata.

5. CYLICODISCUS Harms

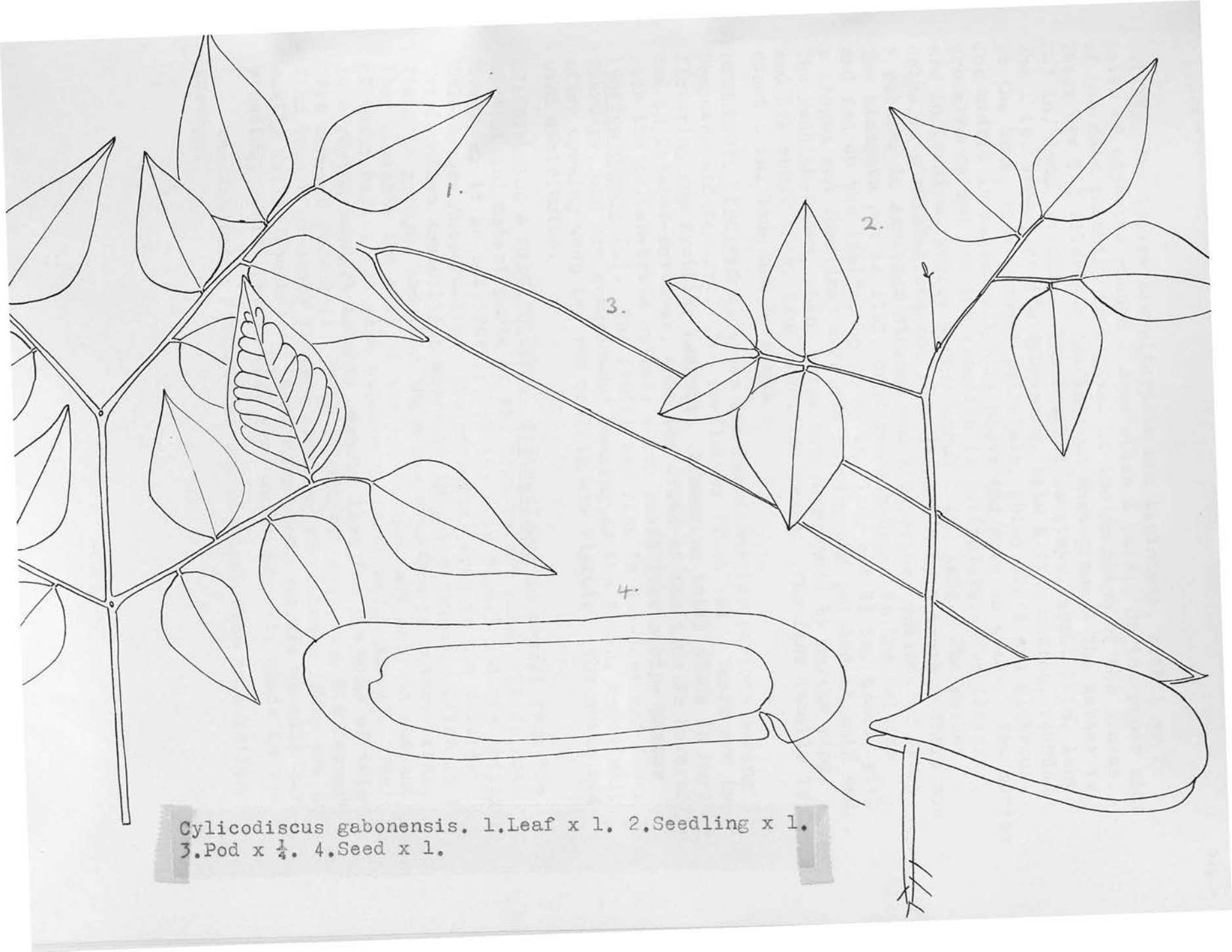
Cylicodiscus gabunensis Harms

SYNONYMS. Cirtoxiphus staudtii Harms Erythrophleum gabunense Taub. Piptadenia sp. (H.N.Thompson's Report on the Forests of the Gold Coast) (43).

VERNACULAR NAMES. Adadua (D,F,W). Denya (Ash,T).

TRADE NAME. Okan.

A very large tree. One felled near Kumasi had a height of 184 ft. 11 in. (bole 79 ft. 8 in.) and 19 ft. 11 in. G.B.H. The bole is clear, straight and cylindrical, with no pronounced buttresses, only root spurs. The stems of young trees are covered with large thorns. This tree has one of the biggest crowns in the forest. The crown is spreading, but regular, and a diameter of 120 ft. is not unusual. Despite its bulk, it is a firm rooted species. The bark is dark brown, flaky and somewhat regularly shaggy. The fibrous slash is fairly soft. Just beneath the brown scales is a purplish layer, under which it is white, becoming yellow quickly. It has a faintly garlic smell. The sapwood appears white to light brown and is hard. The heart is dark reddish-brown, very heavy, about 67 lb. per cu. ft. seasoned, hard and tough, with a coarse texture, interlocking grain, and does not season easily. It is durable. The wood has been used for harbour works at Takoradi and in mines for underground timbers.



Cylicodiscus gabonensis. 1.Leaf x 1. 2.Seedling x 1.
3.Pod x $\frac{1}{4}$. 4.Seed x 1.

BOTANY. The leaves are alternate and bipinnate, with 1 or 2 pairs of opposite pinnae - more often 1 pair. On the upper side of the main rhachis is a gland at the junction of the pinnae. There are 5-7 alternate leaflets on each pinna - the latter is 2-3 in. long, or more. The leaflet is ovate, about 2 in. long and 1 in. broad, entire acuminate, with a fine mucron, rounded at the base, with a short petiolule, shiny above and glabrous. The midrib is raised slightly above and more so below. The nerves are also raised and the venation is reticulate. The flowers are in terminal yellow spikes about 7 in. long. The yellow calyx is pinkish-brown and is represented by 5 teeth. There are 5 petals, 10 exserted stamens and a superior, unilocular ovary. The elongate pod is flat, dull reddish-brown on the outside and red on the inside, up to 27 in. long and $1\frac{1}{4}$ in. broad, with a ridged and sometimes undulate margin, and pointed at both ends. The reddish-brown, shiny seeds are surrounded by narrow wings and are about 4 in. long and 1 in. broad. The fine funicle is about 1 in. long and terminal .

PHENOLOGY. Individual trees are deciduous for periods during December and January. The new leaves flush red. There are two flowering and fruiting seasons. Flowering takes place in March, and in October-November, when the crown of the tree is covered with the golden-brown spikes, which smell like a ripe pawpaw (Carica papaya L.). The fruits are ripe in May-June and January-February, and are conspicuous hanging on the crown, especially after opening when the red insides are visible. The seeds are wind distributed.

DISTRIBUTION & SILVICULTURE. Cylicodiscus is absent from the wettest and driest parts of the High Forest Zone. It is not found, or if so only rarely, in the Rain Forest and the Antiaris-Chlorophora Association. Its principal area is the Celtis-Triplochiton Association where it is quite common. Often it is found in groups, and when these are composed of mature trees, they dominate the rest of the vegetation, not only on account of their height but also because of their crown spread. There is a saying amongst Ashanti farmers that the presence of this tree denotes poor soil. This is not the case, but the farmers find them a nuisance in farm clearing operations. They are not easily felled because of their hard wood, and are usually burt standing. This species will grow under moderate shade in youth.

The following frequencies are obtained from enumeration surveys:

1.

2.

3.

Cylicodiscus gabonensis. 1.Tree. 2.Bole.
3.Flowering branchlet.

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Onuem-Nyamibe Shelterbelt	62	19	8	11	11	33
Asénanyo	96	9	5	6	8	9
Esukawkaw	1440	52	14	13	7	34
Bemu River	104	19	2	6	6	8
Worobong	278	11	4	9	6	18

The large numbers in the Over 11 ft. girth class indicate that this is a long lived tree.

SEEDLING. Germination is epigeal, but the cotyledons lie on the ground and are not carried up the 1. in. long, fairly stout hypocotyl which is twisted because of this. The cotyledons do not develop and are about 3 in. long and 1 in. broad. The shoot isslender and green. The leaves are alternate and the first is borne 2-2½ in. above the cotyledons. It is paripinnate, with 2 pairs of opposite leaflets. The 2nd. leaf is bipinnate with 1 pair of opposite pinnae and each with 2 or 3 alternate leaflets. More leaflets are added in succeeding leaves until 5-7 are reached as in the adult leaf. The leaflet is ovate, about 1¼ in. long and ¾ in. broad, acuminate, with a rounded base, glabrous and with a short petiolule. There is a small raised gland on the upper side of the rhachis, at the junction of the pinnae.

FIELD NOTES. The pods and seeds are sometimes mistaken for those of Piptadenia africana. The Cylicodiscus pod is twice the length of that of Piptadenia. The funicle is terminal in Cylicodiscus and lateral in Piptadenia.

6. PARKIA R.Br.

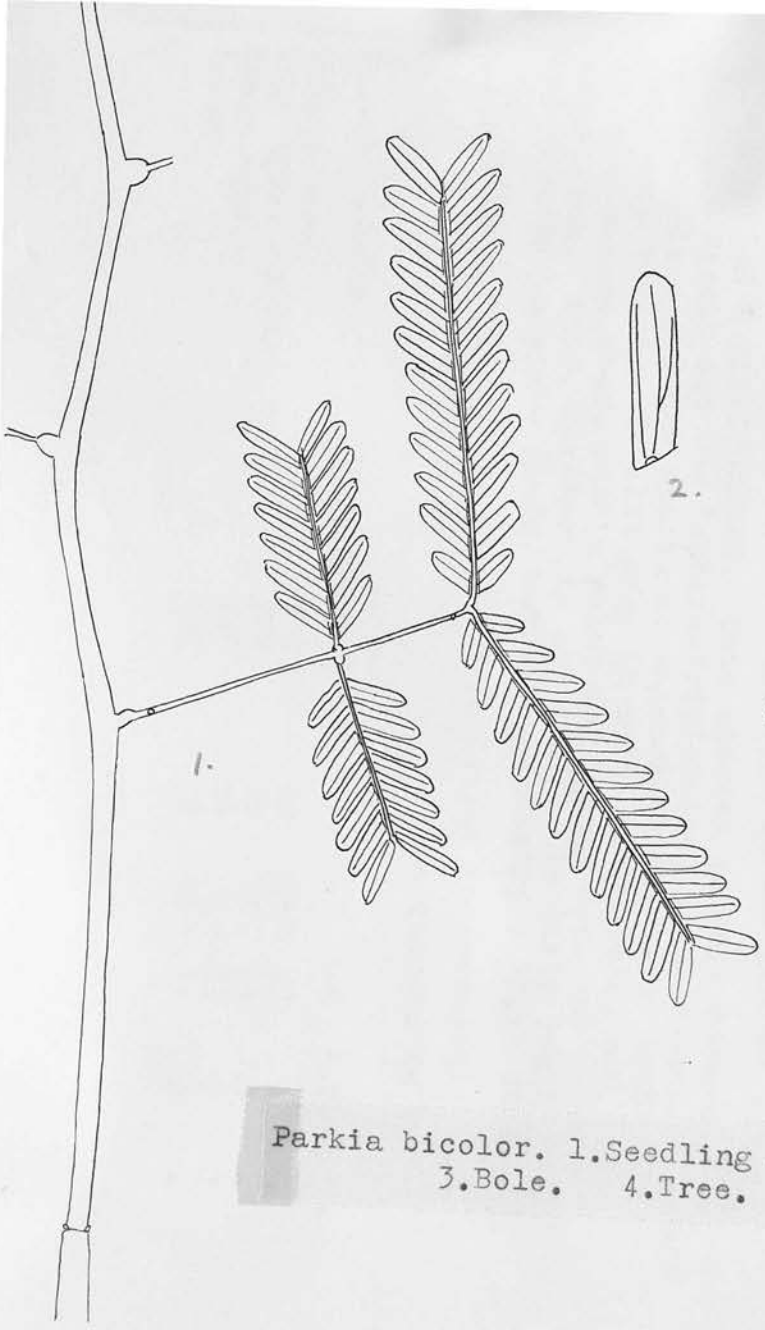
Besides the species described below, there is P. filicoidea Welw., a common tree in the Savannah-Woodland. The pulp around the seed is an important food in the Northern Territories.

Parkia bicolor A.Chev.

SYNONYMS. P.agboensis A.Chev. P. klainei Pierre P. zenkeri Harms

VERNACULAR NAMES. Asoma (Ash,F,T,W). Esuene (Nz).

A tree of about 130 ft. in height and up to about 12 ft. girth. The stem is not very straight and is buttressed to about 7 ft. high. The large spreading crown of dark green foliage is not dense. The bark is dark brown and irregularly flaky. The outer slash is light dull red-brown and the inner slash light brown. A slightly sticky clear sap exudes from the wound.



Parkia bicolor. 1.Seedling x 1. 2.Leaflet x 2.
3.Bole. 4.Tree.

The sapwood is whitish. The heart is brown, fairly light in weight, 29 lb. per cu. ft. seasoned, with a fetid odour when fresh, coarse and woolly in texture and not durable. In transverse section, the scattered vessels are visible. The fairly broad rings of parenchyma around the vessels and the numerous fine medullary rays can be seen with a hand lens.

BOTANY. The leaves are alternate, bipinnate and about 11 in. long (double this length in saplings), with 12-20 pairs of opposite pinnae. The pinna is about 4 in. long on the mature leaf, and consists of up to 50 pairs of opposite leaflets. The leaflet is narrowly oblong, about 0.2 in. in length, entire, with a rounded apex, oblique base and sessile. It is dark green above, lighter green below, ciliate and its midrib is visible to the naked eye from above. The rhachis is rusty pubescent and on its upper side is a large gland above the basal thickening, and smaller ones between the terminal pairs of pinnae. The pendulous, capitate, red, scented inflorescences, about 1½ in. diameter, are borne in 4 in. oeduncles. The flowers are pentamerous and the perianth is much reduced. The 10 stamens and style are exserted. The infructescence consists of an indefinite number of pods - perhaps only one, but usually more. The pod is 12 in. long or less, ¾ in. broad and stalked, and contains up to 20 seeds.

PHENOLOGY. The leaves begin to thin out in September but are never completely bare. The flush of new leaves is a red-bronze colour. Flowering is from November to January and is conspicuous because of the red pendulous balls of inflorescences. The pods mature quickly and are ripe in February and March. They do not remain long on the tree before they fall to the ground.

DISTRIBUTION & SILVICULTURE. This species is more common in the Rain Forest and the Lophira-Triplochiton Association, although individuals are found scattered throughout the Moist Semi-Deciduous Forest. It will grow in moist situations, and even in semi-swamps where raphia palms and Uapaca spp. may be its associates. This, however, is not usual. In early youth it is tolerant of moderate shade, but is essentially a light demander.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Ankasa River	120	18	17	13	6	-
Cape Three Points	129	29	14	11	8	-
Bonsa River	106	56	5	13	1	1
Kakum	150	58	29	14	8	-

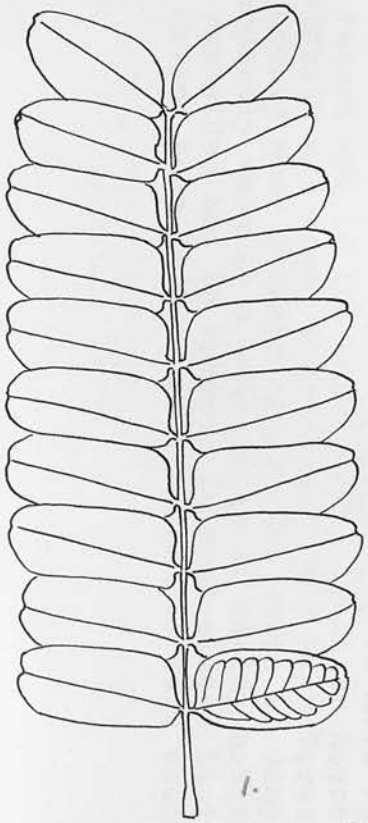
SEEDLING. Germination is epigeal. A long tap is formed. The hypocotyl is sturdy, dull brown, woody, about 3 in. long and 0.15 in. diameter. The cotyledons do not develop. The leaves are alternate and bipinnate. The 1st. leaf is from 2-4 in. above the cotyledons, and consists of 2-3 pairs of opposite pinnae. There are up to 17 pairs of opposite leaflets on each pinna. The leaflet is narrowly oblong, 0.4 in. long and 0.1 in. broad, entire, with a rounded apex or sometimes slightly pointed, an oblique base, sessile, dark green and shiny above and dull, light green below. It is slightly swollen where it is attached to the secondary rhachis. The midrib is raised on both sides and is visible. The principal rhachis and secondary rhachides are pubescent. On the upper side of the principal rhachis, near to its swollen base, is a raised gland, depressed in the centre, and a smaller one between the terminal pinnae. The numbers of pinnae and leaflets increase in succeeding leaves. The seedling is robust and the internodes may be 1½ in. long or greater.

NATURAL REGENERATION. This is usually plentiful, especially as groups under the mother trees. With a lightening of the canopy, the seedlings grow quickly. The sapling is straight and unbranched and annual height increments of 15-27 in. have been recorded in plots receiving canopy treatment under the Tropical Shelterwood System.

ARTIFICIAL REGENERATION. The germination period is about 18 days and about 42% of the seeds germinate. Growth is very rapid and is about 3 ft. in the 1st. year. One lot of plants left in the nursery for 20 months had attained heights of 7 ft. 9 in. to 9 ft. 10 in. by then.

FIELD NOTES. Parkia bicolor and Piptadenia africana are sometimes confused. The main field characteristics may be summarised as under:

Character	Parkia	Piptadenia
Bark	Flaky	Smooth
Buttresses	Dull brown and not extensive	Bright brown and extensive
Rhachis	Glandular	Without glands
Leaflet midrib	Visible	Not visible
Inflorescence	Capitate	Spicate
Seed	Wingless	Winged
Seedling	Robust	Slender
Sapling	Straight - unbranched	Branched and semi-drooping.



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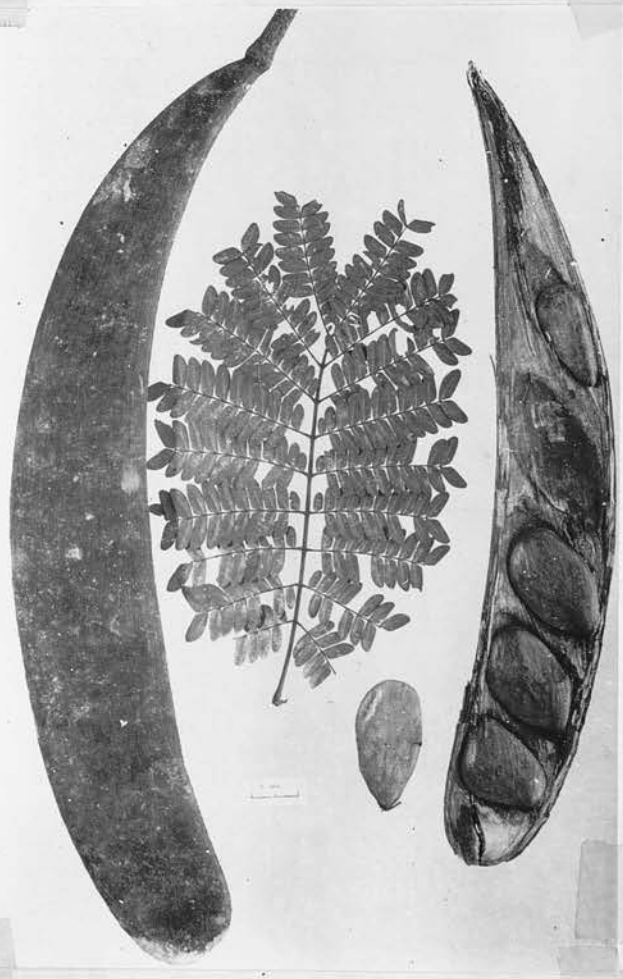

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Pentaclethra macrophylla. 1.Pinna x 1.
2;Pod, seed & leaf. 3.Seedling.

7. PENTACLETHRA Bth.

Pentaclethra macrophylla Bth.

VERNACULAR NAMES. Ataa & Atawa (Ash,F,T,W). Ateba (Nz). Ekuana (F).

Atawa is said to be onomatopoeic from the sound of the bursting pods; it is sometimes applied to other trees with woody, dehiscent pods.

A tree with a height of about 70 ft. but often less. The stem is fairly short, twisted and seldom straight, and with short buttresses or none at all. It is typically branched low and the crown is spreading. The bark is dark grey-brown, with large irregular scales and shaggy. The slash is light yellow-brown. The sapwood is light brown, hard, coarse textured and with prominent vessels. The heart is reddish-brown, heavy, about 50 lb. per cu. ft., very hard, tough, with an interlocked grain and termite proof. The oily seeds are edible.

BOTANY. The large leaves, about 18 in. long and 9 in. broad, are alternate and bipinnate, consisting of about 10 pairs of opposite pinnae, with about 12 pairs of opposite, sessile leaflets to each pinna. The rhachis is without glands. Both the principal rhachis and secondary rhachides are channelled above. Pentaclethra is unique in this family in having rufous, stellate hairs on the principal and secondary rhachides and on the underside of the midribs. The leaflet is oblong, almost 1 in. long and 0.4 in. broad, entire, emarginate, oblique at the base, attached to the secondary rhachis at its lower corner, dark green above and paler below. The midrib is diagonal and raised above and below. The spicate inflorescences are about 4½ in. long and the flowers are pentamerous. In addition to the 5 stamens are 10-15 staminodes. The fruit is a dark brown, hard, woody pod, about 20 in. long and 3 in. broad, curved slightly, rounded and broader at the apex and containing about 5 brown, flattened elliptic seeds, 1 in. long and 0.4 in. broad.

PHENOLOGY. This species is evergreen. Flowering takes place in February-April. The pods begin to ripen in September and may remain on the tree until January. Dehiscence is usually sudden, and by it the seeds are expelled.

DISTRIBUTION & SILVICULTURE. Pentaclethra is more common in the Rain Forest and in the Lophira-Triplochiton Association, but individuals are found elsewhere in the High Forest Zone. Often it occurs near streams and on the edges of damp depressions. It is frequently seen as a small tree of untidy habit and large crown on roadsides and in farms. In such places it is usually a relic, having been left on account of its hard wood.

SEEDLING. Germination is hypogeal. The large cotyledons do not develop and remain within the testa. Their petioles are about ½ in. long. The shoot is dark green and semi-woody. The primary leaves are alternate and bipinnate. The 1st. leaf is about 5 in. above ground and consists of two pairs of opposite pinnae. The rhachis is about 2 in. long and the lower pair of pinnae have 2 pairs of opposite leaflets. On the upper pair there are about 7 pairs. The leaflet is like a parallelogram in shape, about 0.7 in. long and 0.3 in. broad, entire, obtuse, diagonal at the base and sessile. The lamina is dark, shining green above, light green and dull below. The midrib is diagonal and it and the nerves are raised on both sides. The number of pinnae is increased in succeeding leaves. The shoot and rhachides are covered with rufous stellate hairs. Those on the secondary rhachides are particularly common between the leaflets. The latter are weakly ciliate.

ARTIFICIAL REGENERATION. There are about 15 seeds to a pound. Germination takes place in 14-16 days and is about 87%.

8. PIPTADENIA Bth.

Piptadenia africana Hk.f.

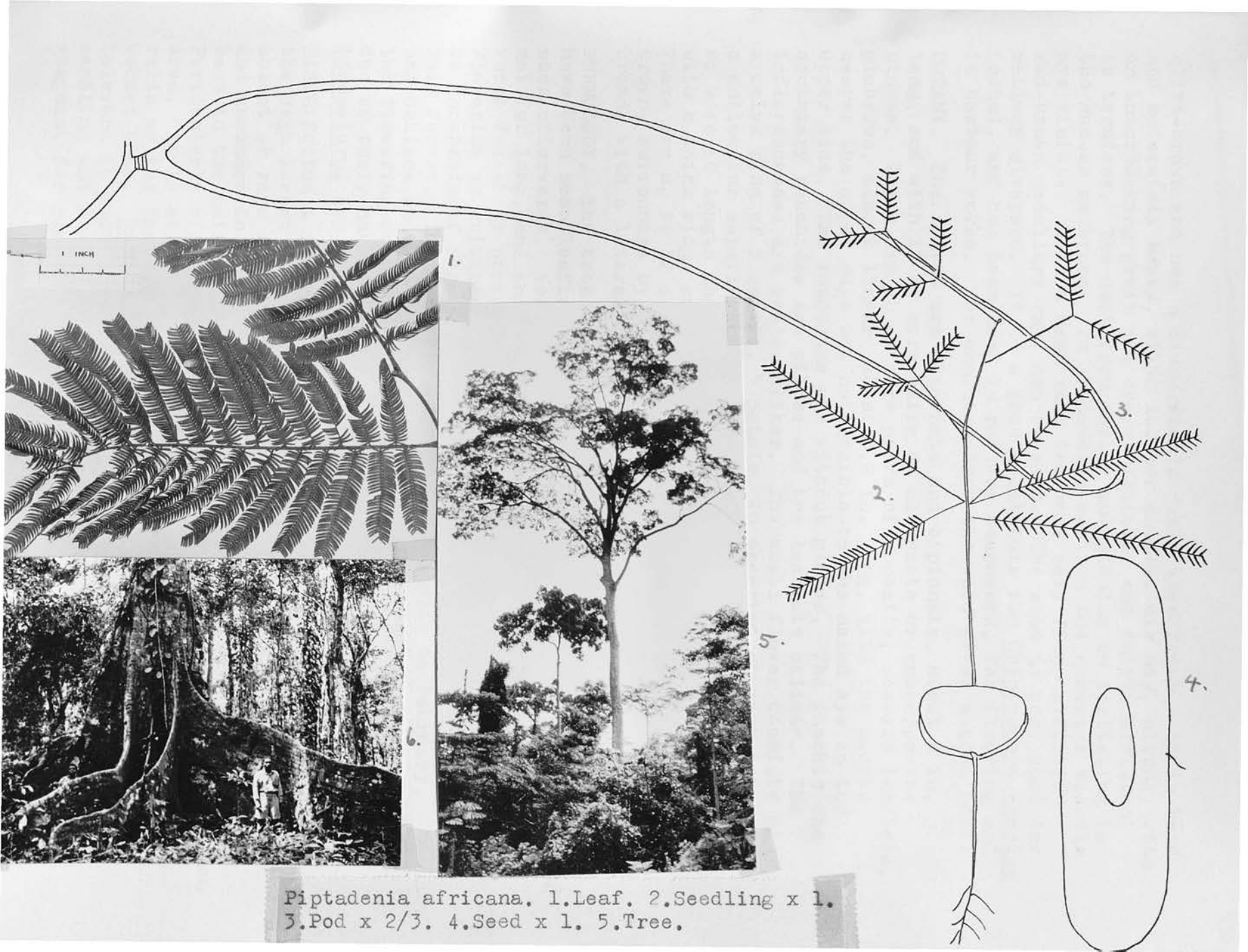
VERNACULAR NAMES. Dabema (Ao,Nz). Dahoma (Ash,F,T,W). Elae (S). Odan (Ash). This last name means a house, and is so called because of the spaces between the buttresses.

TRADE NAME. Dahoma.

One of the emergent trees of the High Forest. Measurements of some felled trees are as follows:

Girth above buttresses	Length of bole	Height of tree
10ft. 1 in.	54ft. 8in.	131ft. 2in.
14 8	59 2	174 6
14 9	54 0	199 1
15 7	62 0	165 8
17 9	49 8	163 0

The bole is typically not straight, and there is usually a slight bend at about 50 ft. The buttresses are diagnostic; they are narrow, red-brown, especially along the upper edges, travel some distance from the tree and curve. They may extend 15 ft. up the stem. The crown is large, spreading, rounded and dark green, but becoming flat and thin in old trees. The bark is light grey and smooth. The slash is light yellow-brown, with black and red irregular lines on the innermost layer in big trees. The sapwood is white and narrow. The heart is



Piptadenia africana. 1.Leaf. 2.Seedling x 1.
3.Pod x 2/3. 4.Seed x 1. 5.Tree.

olive-brown and has a disagreeable smell when fresh. It is hard and moderately heavy, 42-50 lb. per cu. ft. air dry, strong, with an interlocking grain and coarse texture, and fairly resistant to termites. The dust from sawing and planing is irritating to the mucous membrane. In transverse section the numerous vessels are visible. With a hand lens the many very fine, slightly red-brown medullary rays can be seen. The wood is very good for railway sleepers. It is a good substitute for Chlorophora excelsa (odum), and has been used in railway coachwork, for flooring and in harbour works. The charcoal from the wood gives a good heat.

BOTANY. The leaves are alternate and bipinnate, about 8 in. long, and with 12 or more pairs of alternate or sub-opposite pinnae. There are 40 or more pairs of opposite, sessile leaflets, glabrous, almost linear, about 0.2 in. long, with the midrib nearer the upper edge but not visible to the naked eye on the upper side. The rhachides are without glands. The rhachis and secondary rhachides are pilose and the leaflets ciliate. The inflorescences are yellow slikes. The small flower consists of a calyx ring of 5 sepals, 5 petals, 10 exserted stamens and a unilocular superior ovary. The pendulous pod is long, 12 in. or more in length and 1 in. broad, brown, thin, hard and glabrous, with a thick ridge running along the margins, and dehiscent. There are up to 12 seeds in each pod. The seed is shiny, golden brown, surrounded by a thin wing, about $2\frac{1}{2}$ in. long and $\frac{3}{4}$ in. broad, with a lateral funicle.

PHENOLOGY. The tree is irregularly deciduous. Pole size trees have been seen leafless in September, and putting on new leaves soon afterwards. Most of the trees are deciduous in January, but not for long, and some may lose their leaves in February and March for short periods. The flush of new leaves is light brown. Flowering is universal except the very old trees which seem to be incapable of flowering. This is particularly the case in the Rain Forest. The fruits are ripe from December to February, and dehisce on the tree. The seeds are dispersed by wind. In the flowering season, many branchlets can be seen on the ground, due to their having been nibbled through by flying squirrels (Anomalurus spp.)

DISTRIBUTION & SILVICULTURE. P. africana is found throughout the High Forest Zone, except along its northern margin. It is absent or rare in the Mpameso, Bia Shelterbelt and Boumfum F.Rs. and uncommon in Northern Togoland. The tree seems to be at its best in the Rain Forest and in the Lophira-Triplochiton Association. Particularly big ones have been seen in the Enchi to Ankasa F.R. area. It is often seen in Secondary Forest, but is usually a relic as the farmers are not keen to fell this rather hard wooded tree. Piptadenia is a light demander, but is shade tolerant in youth, and in fact, prefers moderate shade in the seedling and sapling stages. It may even remain more or less stagnant for some years where the shade is too great for it to

progress. As a sapling it has a curious, almost recumbent habit. Although not very particular about the soil, it requires moist, but freely draining sites.

The following frequencies are taken from enumeration surveys.

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Cape Three Points	129	17	10	10	5	6
Yoyo	569	157	70	39	26	132
Kakum	150	120	43	25	15	18
Esukawkaw River	1440	932	254	167	219	333
Bobiri	94	20	3	1	1	8

SEEDLING. Germination is epigeal. The hypocotyl is about 1 in. long, woody and straw coloured. The cotyledons do not develop and usually remain folded against the base of the stem. The primary leaves have a curious arrangement. The first is borne about 2 in. above the cotyledons and is paripinnate, about 2 in. long and with about 30 pairs of opposite, small, linear, sessile, glabrous leaflets, about 0.3 in. long. Immediately above this first leaf is a whorl of four similar leaves. The succeeding ones are alternate and bipinnate, usually with one pair of pinnae, and then increasing to two and so on. The stem is dark brown, slender, woody and pubescent. The principal rhachis and secondary rhachides are also pubescent and are without glands.

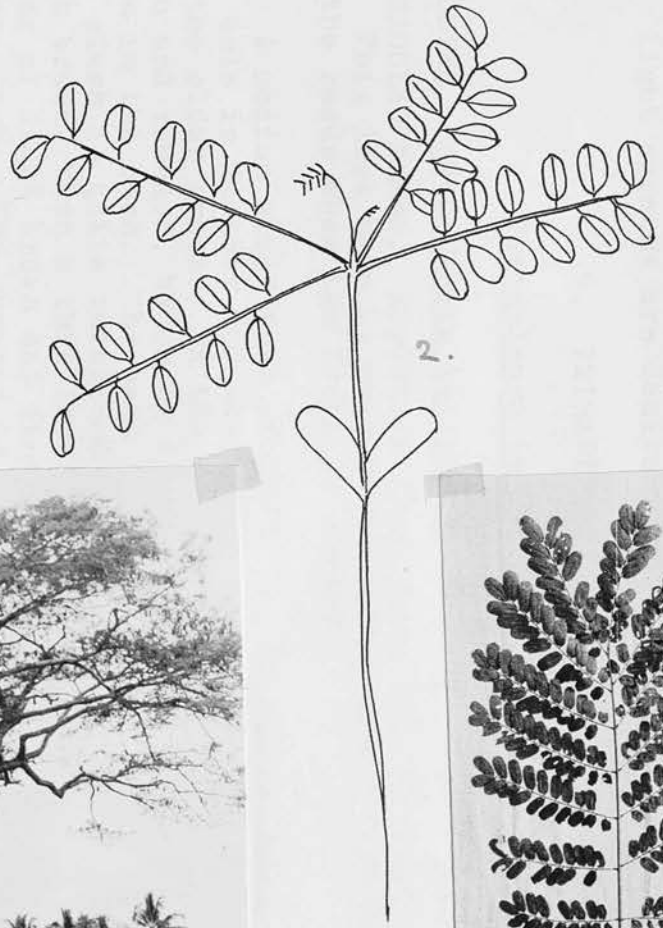
NATURAL REGENERATION. This is abundant, especially under partial shade, and the small seedlings are evident from June onwards. Growth is very slow to begin with, and in the first three years the seedlings may be only 9-15 in. high. After that, growth is quicker if there is sufficient overhead light, and heights of up to 4 ft. have been recorded for 4 year plants.

The following height measurements are from Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
10in.	14in.	33in.	56in.
6	13	28	35
6	10	30	48
7	15	24	44
10	15	20	37
6	11	20	28

ARTIFICIAL REGENERATION. There are approximately 100 winged seeds to an ounce. The seeds do not retain their viability long. The germination period is 15-21 days, and the germination percent about 60. The height growth in the first 6 months may be only

3.



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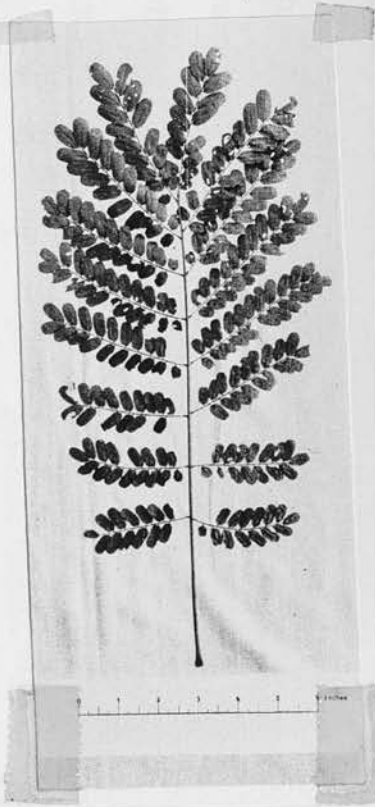


Tetrapleura tetraptera. 1.Leaf. 2.Seedling x 1.
3.Fruit, seed & cross-section of fruit. 4.Tree.

5 in., but can be 2 ft. 3 in. at the end of a year and 3 ft. 6 in. in 18 months, when the plant percentage should not be less than 55. Light screens are desirable over the nursery beds.

9. TETRAPLEURA Bth.

Tetrapleura tetraptera Taub.

SYNONYMS. Adenanthera tetraptera Schum.& Thonn. T.thonningii Bth.

VERNACULAR NAMES. Epelekese (Nz). Esem (F). Prekese (Ao,Ash,Nz,T,W). This last name is said to be onomatopoeic from the sound of the seeds when the fruit is shaken.

A medium sized tree of 50-70 ft. in height and 5 ft. girth. The bole is slender and there are very small, low, sharp buttresses in the older trees. In the forest, the crown is fairly small, thin and rounded, becoming flat when old, but it tends to spread when in the open. The bark is grey-brown and fairly smooth. The slash is quite thick and layered. On the outside it is dark brown, then a thin layer of reddish-brown, next a thin layer of light brown and finally the fairly thick pinky-brown inner slash. The sapwood is white and shows ripple marks. The heart is red-brown, of medium hardness, easily worked and split. It has an unpleasant odour when fresh. In transverse section, the irregular parenchyma is visible. With a hand lens the parenchyma can be seen surrounding the vessels and joining into short, irregular bands. There are also occasional narrow, short transverse bands. The medullary rays are fine and numerous. An infusion from the bark is made for a cure for constipation. The sweet smelling fruits are used in native soups and in pomades.

BOTANY. The alternate leaves are bipinnate, about 8 in. long, and consist of about 8 pairs of opposite pinnae. There are about 12 pairs of alternate leaflets on each pinna. The leaflet is oblong, about $\frac{1}{2}$ in. long and 0.3 in. broad, entire, rounded apex and base, sometimes very slightly emarginate and with a very short petiolule. The midrib is visible but the venation is inconspicuous. The principal and secondary rhachides, petiolules and the undersides of the midribs are red-brown pilose. The yellow inflorescences are in axillary spikes, about $2\frac{1}{2}$ in. long and $\frac{1}{2}$ in. broad, on a peduncle 1 in. long. The calyx is reduced to 5 teeth. There are 5 petals, 10 exserted stamens and a superior unilocular ovary. The pod is 6-9 in. long, 4-winged. purplish-brown, shiny, pendulous, indehiscent, woody and sweet smelling. It contains numerous small wingless seeds, each in its own compartment.

PHENOLOGY. The tree is deciduous in December. Flowering begins towards the end of February and is over in early April. The pods

Xylia evansii. 1.Seedling . 2.Leaf.
3.Opened pod, All x 1. 4.Bole.

are ripe from September to December. They are indehiscent, and when they fall from the tree they attract small animals by their smell. One pair of opposite wings is less woody than the other pair.

DISTRIBUTION. Tetrapleura is found throughout the High Forest Zone, in Riverain Forest in the southern Savannah-Woodland and in Forest Outliers in the Afram Plains. It is at its best in the Rain Forest and the Lophira-Triplochiton Association, and some well shaped trees raching an estimated height of 85 ft. have been seen from the Yoyo F.R. to the Ankasa F.R.

SEEDLING. Germination is epigeal. The slender hypocotyl is about 1½ in. long. The cotyledons do not develop and are oblong, about 0.4 in. long and 0.1 in. broad. sessile and auriculate at the base. The first primary leaves are borne about 1¼ in. above the cotyledons and are in a whorl of four. The leaf is stipulate and paripinnate, with 10-14 alternate leaflets. The leaflet is oblong, 0.3 in. long and 0.15 in. broad, entire, pilose, rounded and with a very short petiolule. The succeeding 1 leaves are alternate. The seedling is delicate.

ARTIFICIAL REGENERATION. There are about 176 seeds to an ounce, and germination begins in 6 days.

10. XYLIA Bth.

Xylia evansii Hutch.

VERNACULAR NAMES. Kotoprepre (Ash,W). Samantaa (Ash,T,W).
See also Bussea and Calpocalyx. Saman means a spirit and ataa is a bean from a hard, woody, dehiscent pod. The name means the bean which is not eaten but left for the spirits.

A medium to large tree. A felled specimen measured 97 ft. high (bole 56 ft.) and 8 ft. 6 in. above buttresses. A large one in the Subri F.R. has a girth above buttresses of 10 ft. 9 in. and an estimated height of 115 ft. The bole is usually not straight and not longer than 40 ft. (In the pole stage the stem is rather zigzag). Buttresses develop early; they are wide at the base and may reach a height of 13 ft. The crown is composed of large branches rising from the comparatively short bole; it is thin, spreading and becomes flattened. The bark is dark brown and rough. The scales leave irregularly shaped and prominent depressions when they flake off. The thin slash is yellow-brown, but light brown immediately below the scales, and it has a slightly sweet smell. The sapwood is yellow. The heart is reddish-brown, hard, heavy and dense, with a fine texture but difficult to work. It is reasonably durable against fungi and insects.

BOTANY. The leaves are alternate and bipinnate with but one pair of opposite pinnae. The stipules are linear and persistent. There is a raised gland at the junction of the pinnae and smaller ones between the leaflets. The principal rhachis is about 2 in. long and the secondary rhachides about 6 in. The pinna has about 9-15 pairs of opposite leaflets, with the smallest at the base and apex. The leaflet is oblong-lanceolate, about 1½ in. long and ½ in. broad, acuminate, rounded at the base and with a very short petiolule. The principal rhachis, secondary rhachides and the undersides of the leaflets are slightly pubescent. The inflorescences are yellow, capitate and about ¾ in. diameter. The small flower is pentamerous, with a pubescent perianth; the 10 stamens are exserted; the ovary is superior, unilocular and with a short style. The dehiscent pod is about 7 in. long and 1¼ in. broad, brown, woody, hard, sickle shaped, with a beaked apex and attenuated base, and containing about t seeds. The impressions of the seeds are left on both halves of the pod on theinside.

PHENOLOGY. The tree may be deciduous for a short period in December. If the harmattan is not severe, the new flush appears before all the old leaves have fallen. Flowering takes place from mid February to early April. The pods ripen from November to January, and are conspicuous as they project from the crown. In dry weather they dehisce with quite a loud crack, curl backwards and expel the seeds.

DISTRIBUTION & SILVICULTURE. Xylia is scattered throughout the High Forest Zone. It belongs to the upper canopy, but usually in the lower stages of it. Because of its poor habit, it is not a desirable tree economically nor silviculturally. Often it is found in moist situations, such as the edges of depressions and near streams.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11--
Kakum	150	51	11	1	1	-
Bobiri	94	25	3	2	4	1
Pamu-Berekum	82	21	23	13	6	-

SEEDLING. Germination is epigeal. The hypocotyl is about 1½ in. long, woody and light brown. The cotyledons do not develop. The stem is slender, woody, brown and pubescent. The 1st. two leaves are borne 2½ in. above the cotyledons and are opposite and bifoliate. The slender petiole is 1 in. long and pubescent. The leaflet is elliptic, 2½ in. long and 1¼ in. broad, entire, acuminate, slightly unequal at the base and rounded, and with a very small petiolule. There are sparse hairs on the underside of the leaflet. The succeeding leaves are alternate, paripinnate, and then bipinnate. The linear stipules are about 0.2 in. long.

MORACEAE.

Most of the members of this family are trees and shrubs; herbs are rare. Many of them contain a milky latex. The leaves are usually alternate, simple and with pired caducous stipules which often leave scars. The flowers are small, unisexual, apetalous, with an inferior or superior ovary of 2 carpels, one of which usually aborts, and with only one ovule. The fruit is a drupe, or often multiple consisting of achenes. The plants may be monoecious or dioecious.

This family contains the large genus of Ficus L. - a woody genus which includes trees, shrubs, climbers and epiphytes. Myrianthus P.Beauv. is represented by 3 species in the lower storey of the High Forest; they are common and have low and very spreading crowns.

GENERA. 1. Antiaris Lesch. 2. Bosquiea Thou. 3. Chlorophora Gaud. 4. Morus L. 5. Musanga R.Br. 6. Treculia Decne.

1. ANTIARIS Lesch.

SPECIES. (i) A. africana Engl. (ii) A. welwitschii Engl.

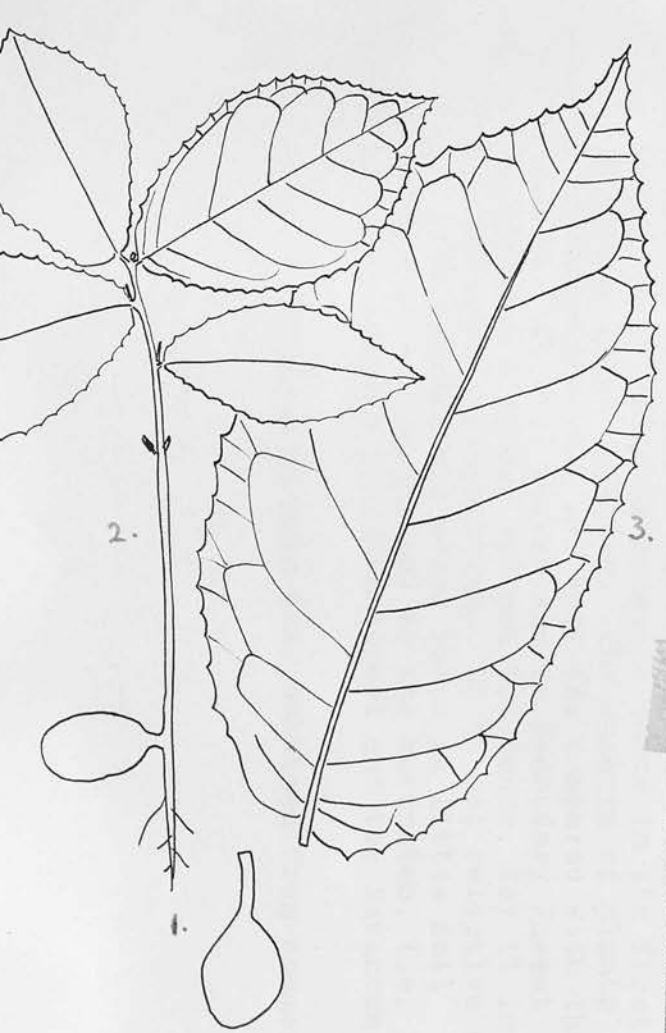
(i) Antiaris africana Engl.

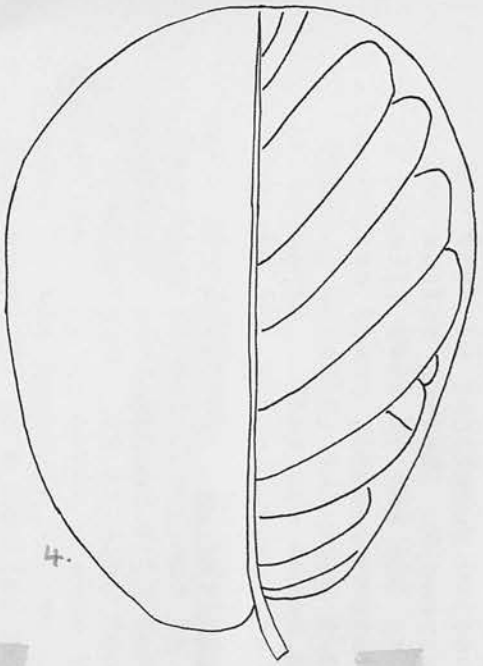
SYNONYMS. A. kerstingii Engl.ex A.Chev. A. toxicaria Lesch. A. toxicaria Lesch. var. africana Scott Elliot

VERNACULAR NAMES. Bofun (Nz). Egyan (Ao,Nz,S). Hachu (Ad). Honton (F). Kodzo (Ga). Kyenkyen (Ash,F,T). Logotsi (E). Commonly called the Bark Cloth Tree.

TRADE NAME. Antiaris.

A tall tree. One felled specimen had a height of 170 ft., with a bole of 116 ft. and 13 ft. 2 in. G.B.H. The bole is straight and cylindrical. Buttress development is variable in that it may or may not occur. But old trees, especially those growing in isolated positions, tend to develop small buttresses. The crown is dark, regular and rounded, becoming flattened in old age. The bark is light grey, smooth and with prominent lenticels. The slash is thick, light yellow-white, with a thin emerald green layer immediately below the bark. There is a copious exudation of slightly sticky latex, with the colour of milky tea. There is no difference in colour between the sapwood and heart - both are white to yellowish. The heart is light, 27-33 lb. per cu. ft. air dry, rather coarse in texture, not durable, and the logs are very liable to stain and borer attacks in the forest. In transverse section, the vessels, the little parenchyma and the numerous medullary rays are visible. The soft wood is used for cutlass handles and wooden domestic utensils. The latex was once used as a rubber adulterant.





Antiaris africana. 1.Fruit.
2.Seedling. 3.Juvenile leaf.
4.Leaf. All x 1. 5.Tree. 6.Bole.

Form the bark a Bark Cloth is obtained, which was used in the Gold Coast for clothing before the advent of European cloths to the country.

BOTANY. The leaves are alternate, simple and stipulate - a pair of small caducous stipules. The leaf is ovate- or obovate-elliptic, about 3½ in. long and 2½ in. broad, entire, rounded at the apex or slightly acuminate, unequally cordate at the base, scabrid above, pubescent below and with a short petiole. The midrib and nerves are raised below. The juvenile leaf is oblong-elliptic, markedly dentate and not scabrid. The trees are dioecious, but Aubréville ( ) records that sometimes they are monoecious, with the male and female flowers on different branches. The male flowers are capitate and consist of 4 green sepals and 4 stamens. The female are solitary and have only a superior ovary of 2 united carpels. The fruit is a deep red ellipsoid drupe, about ½ in. long and 1-seeded.

PHENOLOGY. The tree is deciduous between November and February, but not for the entire period. Flowering takes place at the same time, but is usually over by the end of January. Often the flush of new leaves takes place immediately after flowering. The fruits develop quickly, and ripe ones are available from mid December to April. They are eaten by birds, but large quantities fall to the ground under the mother trees.

DISTRIBUTION & SILVICULTURE. A. africana is distributed throughout the High Forest Zone, but is more common in the northern margin and in Togoland - in fact, in the Antiaris-Chlorophora Association. It is also found in the Derived Savannah-Woodland. It is quite common in Secondary Forest, and also occurs in the Riverain Forest of the southern Savannah-Woodland. This species, in a smaller form, is one of the few trees to be found in the Coastal Scrub and Grassland. Although capable of endurable of enduring moderate shade in its first year, it is a strong light demander. The numbers of plants passing into their second year are very few compared with the seedlings produced. It will regenerate in Secondary Forest only if the shrubs and climbers are not too dense, for it is unable to overcome severe competition. It is not selective of soils and will grow successfull where there is little soil moisture and where it may be exposed to the harmattan, i.e. in the transition belt between the High Forest and the Savannah-Woodland.

The following frequencies have been obtained from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Bobiri	94	24	8	5	2	6
Asenanyo	96	25	15	4	3	3
Afram Headwaters	185	39	26	10	16	10
Northern Scarp East	100	21	4	10	6	16
Odomi River	43	21	23	13	5	3

SEEDLING. Germination is hypogeal. The shoot is dark brown and pilose. The leaves are alternate and the brown, acicular stipules are paired. The first leaf is borne about 2 in. above the ground and is simple, obovate-elliptic, about $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. broad, acuminate to acute, with an unequally cordate base, and a very short petiole. The lamina is pilose on the midrib, nerves and veins, particularly on the upper side.

NATURAL REGENERATIO. This is often so plentiful beneath a mother tree that the seedlings form a carpet. Regeneration is also found in most forest gaps, due to the distribution of seeds by birds. Where there is sufficient light, growth is rapid. This is very evident in such open places as farms, whereheight increments of 15-27 in. are quite usual in the first few years.

The following height measurements were taken in Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
12in.	14in.	17in.	26in.
8	14	25	49
9	16	27	36
6	10	25	38
12	27	33	36

In such plots the overhead canopy is usually not quite light enough for the full development of this species, and so the height growths are less than those in the more open places.

The young plant coppices readily, and strong shoots are produced.

ARTIFICIAL REGENERATION. There are about 59 seeds to an ounce. The germination period is about 19 days. With fresh seed, germination percentages of 87-93 have been obtained. Growth in the nursery is rapid, and heights of up to 4 ft. 3 in. have been recorded at the end of a year. Only light shade is necessary on very sunny days. In a small experimental plot, A. africana plants had attained a height of 13 ft. 6 in. and $7\frac{1}{2}$ in. G.B.H. in 7 years.

PATHOLOGY. Seedlings are prone to aphid attacks, both in the forest and in the nursery. They may cause a die-back of the shoot.

NOTES ON THE PREPARATION OF BARK CLOTH.

Straight stems with undamaged bark and 2ft.-6ft. G.B.H. are preferred. The tree is felled and cut into approximately 6 ft. lengths. The bark is beaten with a piece of wood and then a longitudinal cut is made the whole length of the log. Wedges are driven in and the bark is eased off the log in one piece. The outer bark is scraped with a knife. If a brown colour is desired, the bark is immersed in a stream for a day or two, but no immersion takes place if a light colour is wanted. The bark is beaten with a round piece of wood and then stretched by hand. Itiis washed in running water until all the outer bark disappears. Sometimes it may be rubbed with sand at this stage. The bark cloth is then hung up to dry.

(ii) Antiaris welwitschii Engl.

Whether this is a separate species or a variety of A. africana is not certain. Aubreville ( ) recognises the two species: "The two West African species are easily separated -

Leaves scabrid above, pubescent below. A network of veins prominent below	A. africana
Leaves glabrous, veins obliterated	A. welwitschii."

He also states that A. welwitschii is confined to the "coastal region (rain forest)".

To date, insufficient taxonomix work has been done on this in the Gold Coast. Observations may be summarised as follows: Antiaris trees with glabrous leaves have been found some 150 miles north of the Rain Forest, in the Bobiri F.R. The seedlings raised from seeds collected from those trees have all had pubescent leaves. Even in the Rain Forest I have not found an Antiaris seedling or sapling with glabrous leaves. The habit and slash of these smooth leaves trees appear the same as the scabrid and pubescent leaved ones. Although there may be two distinct species, it is suggested that under certain conditions the leaves of old trees cease to be pubescent.

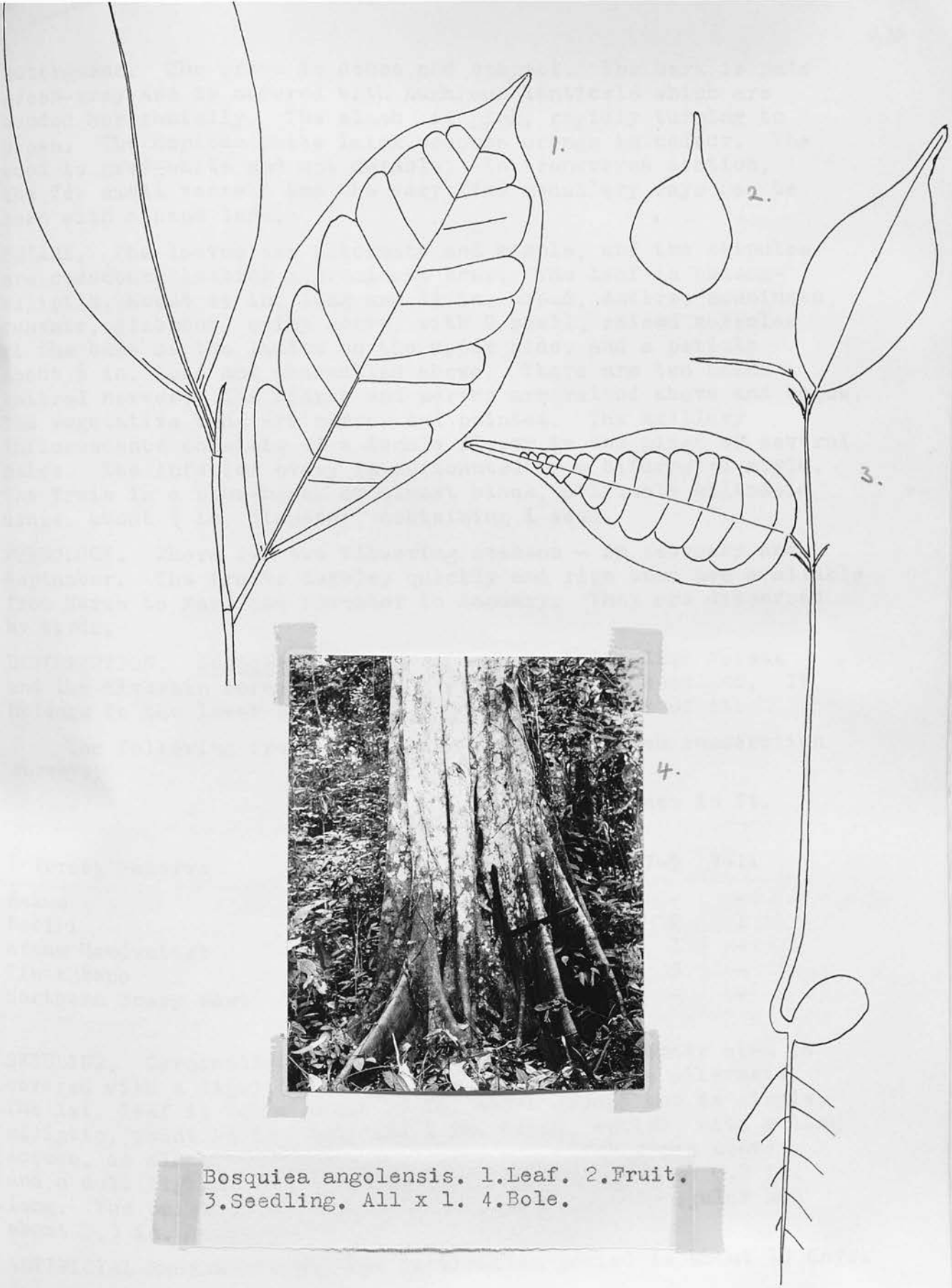
2. BOSQUIEA Thou.

Bosquiea angolensis Ficalho

SYNONYM. Pontya excelsa A.Chev.

VERNACULAR NAMES. Ahiriwa (S). Okuri (Ash,T,W).

A medium sized tree with a fluted and twisted stem and no



Bosquiea angolensis. 1.Leaf. 2.Fruit.
3.Seedling. All x 1. 4.Bole.

buttresses. The crown is dense and compact. The bark is pale green-grey and is covered with numerous lenticels which are banded horizontally. The slash is pink, rapidly turning to brown. The copious white latex becomes orange in colour. The wood is grey-white and not durable. In transverse section, the few small vessels and the very fine medullary rays can be seen with a hand lens.

BOTANY. The leaves are alternate and simple, and the stipules are caducous, leacing a prominent scar. The leaf is oblong-elliptic, about 4½ in. long and 1½ in. broad, entire, acuminate, cuneate, glabrous, sniny above, with 2 small, raised auricles at the base of the lamina on the upper side, and a petiole about ½ in. long and channelled above. There are two basal lateral nerves. The midrib and nerves are raised above and below. The vegetative buds are narrow and pointed. The axillary inflorescence consists of a female flower in the midst of several males. The inferior ovary is surmounted by a bifurcated style. The fruit is a blue-black or almost black, obliquely ellipsoid drupe, about ¾ in. diameter, containing 1 seed.

PHENOLOGY. There are two flowering seasons - in February and September. The fruits develop quickly and ripe ones are available from March to May, and November to January. They are dispersed by birds.

DISTRIBUTION. Bosquiea is common throughout the High Forest and the Riverain Forest of the southern Savannah-Woodland. It belongs to the lower storey but in the upper parts of it.

The following frequencies have been taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Kakum	150	44	2	-	-
Bobiri	94	54	6	2	1
Afram Headwaters	185	192	91	1	-
Tinte Bepo	110	124	29	3	-
Northern Scarp East	100	56	3	-	-

SEEDLING. Germination is hypogeal. The green slender stem is covered with a light down. The primary leaves are alternate. The 1st. leaf is borne about 3½ in. above ground and is simple, elliptic, about 2½ in. long and 1 in. broad, entire, with a long acumen, an almost rounded base, glabrous, shiny green above and a dull lighter green below. The petiole is about 0.2 in. long. The paired stipules are brown, narrowly triangular and about 0.3 in. long.

ARTIFICIAL REGENERATION. The germination period is about 13 days.

3. CHLOROPHORA Gaud.

This genus has long been recognised by the natives of the Gold Coast as providing a most useful timber which is reasonably termite proof - a very important factor in a tropical country. There are two species, two different crown formations, two colours of heartwood in the newly felled trees, and the plants are dioecious. Various theories have been put forward why one tree should have a lighter coloured heartwood than another. These have been associated with sex, species and soil, but so far there does not appear to be anything that is sufficiently conclusive to be accepted as a generalisation.

SPECIES. (i) C. excelsa Bth.& Hook.f. (ii) C. regia A.Chev.

(i) Chlorophora excelsa Bth.& Hook.f.

SYNONYM. C. alba A.Chev.

VERNACULAR NAMES. Elui (Ao,S). Elunli (Nz). Odum (Ash,F,T,W).

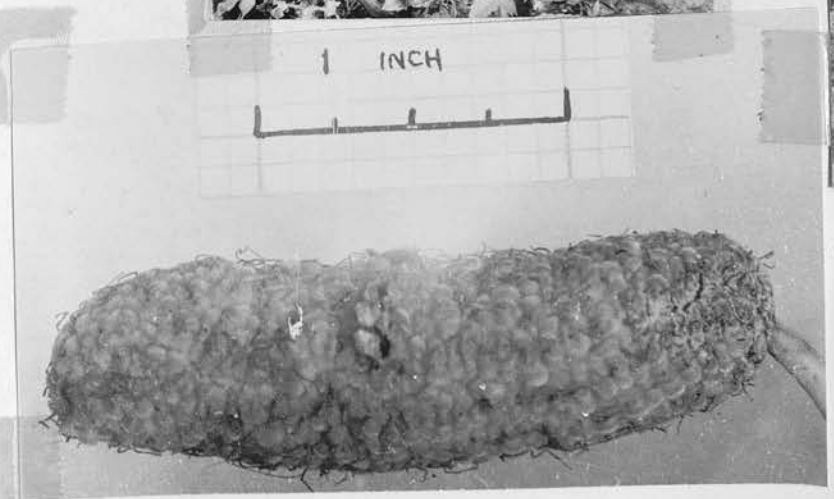
TRADE NAME. Iroko.

A big, emergent tree. Measurements of some felled trees are as follows:

Girth above buttresses	Length of bole	Height of tree
10ft. 7in.	90ft. 4in.	176ft. 6in.
12 9	100 0	160 1
14 0	81 0	157 9
18 3	76 6	156 4

The stem is tall and cylindrical. There are no true buttresses, but in the old trees the root spurs may show considerable development. The roots are most conspicuous, as they are red with long yellow, horizontal lenticels. The upper part of some of the larger roots is exposed on the surface of the ground. They travel a long way and may be seen in the closed forest when the tree is not within sight. The dark foliage and the heavy branches make the crown rather conspicuous. There are two crown formations, one where the branches are ascending, and the other where they are more horizontal. The natives claim to be able to tell the sex of the tree by the type of crown, but both types have been observed in each sex. The bark is brown, with numerous lenticels, and becomes scaly. It is thick and very hard. The slash is yellow-brown and granular, and a copious, white, sticky latex exudes from it. The sapwood is yellow. The fresh heart may be yellow-brown or brown, but in both cases it darkens in time, although not necessarily to the same intensity. The heart is hard, about 41 lb. per cu. ft. at 15% moisture content, with a coarse, interlocking grain, but with good working

3.



2.

1.

4.

Chlorophora excelsa. 1 & 2. Tree with different crown types. 3.Bole. 4.Fruit.

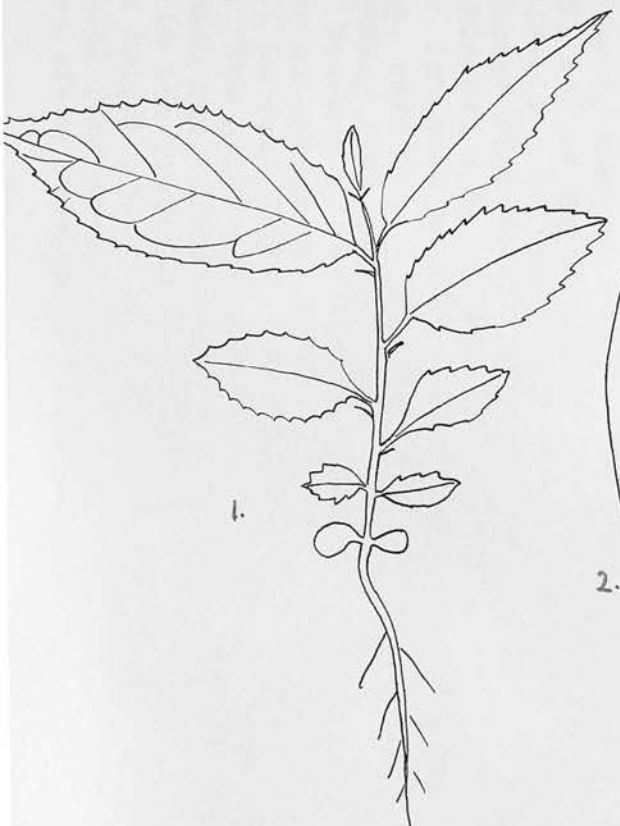
qualities. It is durable, almost termite proof and is listed by the London County Council as fire resistant. Female trees are preferred by pit sawyers, as they say the wood is easier to saw. In transverse section, the comparatively few vessels are barely visible but the continuous parenchyma bands are prominent. The fine medullary rays can be seen with a hand lens. In longitudinal section, the parenchyma shows up as lighter vertical flecks and gives a pleasant appearance to the wood. The timber is used in a variety of ways for constructional work, joinery and cabinet making, and for making native food mortars.

The occurrence of "stone" in the wood of Chlorophora has long been known. Its composition is mainly calcium carbonate, and according to Farmer and Campbell (17)... "It is now generally agreed that these deposits arise through gradual evaporation of the water from sap which has seeped into a cavity of the growing tree. The cavity may be the result of splitting, wounding or decay of the wood". These two authors also describe (17) the finding of another crystalline substance associated with this "stone", and which they suggest is a hydrate of calcium malate.

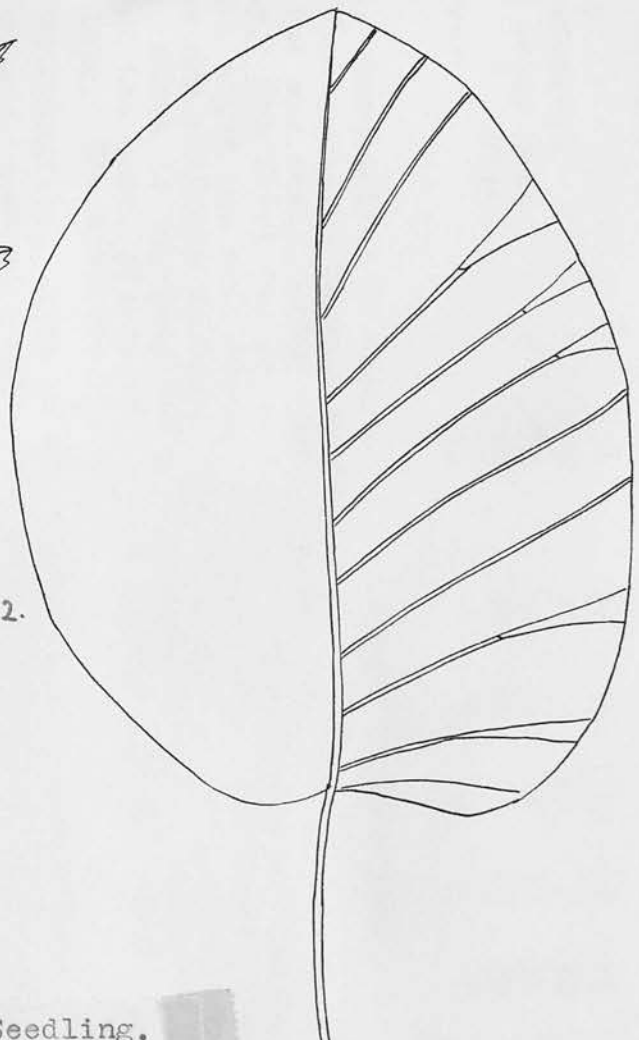
BOTANY. The leaves are simple and alternate, and the stipules are caducous. The leaf is elliptic, about 4½ in. long and 3½ in. broad, entire but with slightly undulate margins, with a short acumen, obtuse or almost rounded, cordate at the base, coriaceous, and with a petiole about 1½ in. long. The midrib and nerves are prominent below and the venation is reticulate. The underside of the lamina is slightly pubescent. The juvenile leaf is very different, being oblong-lanceolate, up to 10 in. long and 2½ in. broad, serrate, acuminate, cordate, not coriaceous, with a short petiole and pilose. The tree is dioecious, and the pendulous inflorescences are axillary. The male catkins are up to 9 in. long, and the small flower consists of 4 sepals and 4 stamens. The female catkin is about 1½ in. long and ½ in. diameter, and the small flower contains 4 sepals and a perigynous ovary of 2 united carpels surmounted by a style. The aggregate fruit is composed of small achenes.

PHENOLOGY. The trees are deciduous in December and January. Saplings not bigger than 5 ft. high are deciduous when in the open. Flowering begins in December and may continue until March. The fruits ripen quickly and are available from March to May. Seed dispersal is mostly by birds and bats, although many of the fruits fall beneath the mother trees.

DISTRIBUTION & SILVICULTURE. C. excelsa is found throughout the High Forest Zone, in the Derived Savannah-Woodland and in the Riverain Forest. It is never frequent except along the northern margin of the High Forest, i.e. in the Antiaris-Chlorophora Association. In the area between Begoro and the Worobong F.R. it is noticeably common. This tree is usually left by farmers when making new clearings because its worth as



1.



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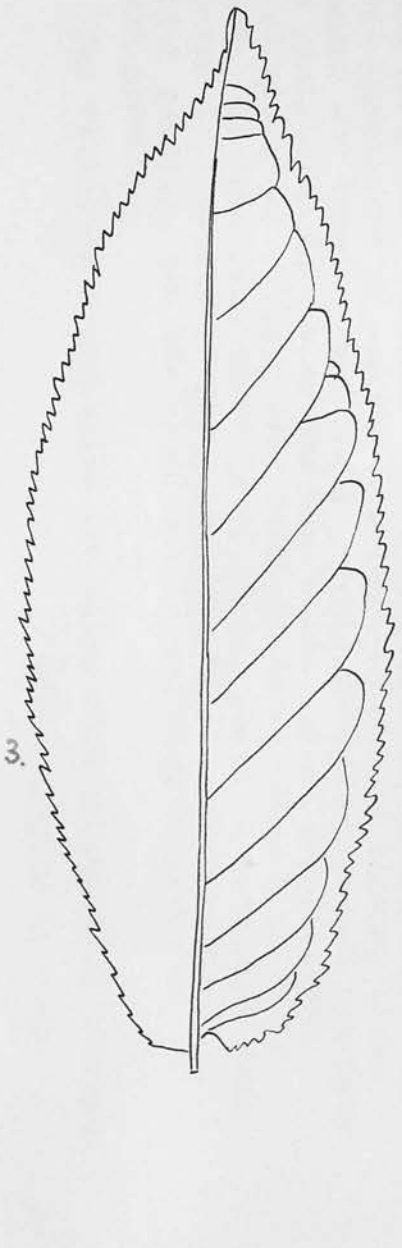


3.

Chlorophora excelsa. 1.Seedling.
2.Leaf. 3.Juvenile leaf. All x 1.

timber is recognised. Likewise it is often to be seen in and around towns and villages. C. excelsa prefers well drained soils and is intolerant of impeded drainage. It is an intense light demander and cannot stand shade. Young Secondary Forest provides poor conditions for it as the weak shoot cannot compete with the climbers and shrubs, even although it is capable of rapid growth. It does best under light shade, where it is almost free from the gall attack of Phytolyma lata Scott. Young stems coppice readily, and the stool shoots are very vigorous in height growth.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Oda River	436	106	46	32	16	29
Afram Headwaters	185	11	4	10	9	40
Northern Scarp East	352	15	14	16	18	32
" " West	577	25	28	27	41	28
Odomi River	43	5	8	2	4	3

SEEDLING. Germination is epigeal. A tap root is developed early. The hypocotyl is only about 0.6 in. long. The cotyledons expand, but are small, being about 0.4 in. long and more or less spatulate. The first two primary leaves are opposite and are about ¼in. above the cotyledons. The succeeding leaves are alternate and increase in size. The 5th. leaf is simple, oblong-elliptic, about 1¼ in. long and ½ in. broad, serrate, acuminate, rounded at the base, pilose and with a slender petiole about 0.2 in. long. The stipules are short.

NATURAL REGENERATION. Most of the natural regeneration occurs in open places, such as along road sides and hauling tracks in the forest, and in newly cleared farms. Where the weed growth is not excessive, the seedlings develop rapidly. In a Light Density Canopy Plot of the Tropical Shelterwood System in the Afram Headwaters F.R., 2 year old saplings of C. excelsa, growing in intimate mixture with Terminalia ivorensis and T. superba, were 6ft. 10in. high. The plot had been weeded and was reasonably free of climbers. Much of the natural regeneration succumbs because of the canopy being too dense or too light - the latter condition not being a direct cause as this species grows best in full light, but indirect due to the incidence of the gall. The galls are commonest where the plants are in the open. Under good conditions, i.e. a high, light shade, as is aimed at in the Tropical Shelterwood System during the regeneration period, a height growth of 3 ft. is not unusual in the first year. This initial fast growth is not maintained. The succulent young shoots are often browsed by duiker.

ARTIFICIAL REGENERATION. There are about 8,000 seeds to an ounce. The viability of the seeds soon diminishes. With fresh seed the germination period is about 16 days, and germination percentages of up to 88 have been recorded. The fruits are best mashed up in water and washed in a few changes, dried and sown broadcast. The seedlings can be pricked out and transplanted when 3 weeks oo old. They must be grown under screens or else the infestation of galls is rapid and severe. Heights at 6 momths vary between 2ft. 6in. and 3ft. 6in., and in 1 year the plants are up to 6ft. high. They can be used at this stage for plantation work either as stumped or stripped plants. But their establishment in the open conditions of a plantation is difficult because of the plants being very vulnerable to gall attacks.

A remarkable feature of the sapling is the large tap root. A plant in the Subri (S.W.) F.R. Nursery, although 3 years old, was only 2ft. 3in. high, owing to repeated gall attacks. On attempting to dig up the plant, the taproot was broken at a depth of 2ft. 9in. It was sturdy, yellow, with prominent lenticels and 9in. below ground it had a diameter of 1in. The subsoil was composed of ironstone concretions.

PATHOLOGY. According to Eggeling (15), the adult hemipterous fly, Phytolyma lata, Scott, lays its eggs, 30-60 at a time, on the shoots and leaves of the young plants. The larvae burrow into the soft tissues of the buds, leaves and young shoots and galls are produced about 9 days after egg laying, because of the irritation to the plant tissues. The fly develops, and in another 12 days the gall splits and the adult fly emerges. The galls cause a loss of leaves and buds and so growth is retarded. Other buds develop which in turn are liable to be infected. A very branched plant results if it is not killed by the attacks. Once the plant has reached a height of 12ft. or more it is almost free from attack. Its recovery is certainly easier at this stage.

Remedial measures are not easy. The galls may be slit in the nursery or in plantations and the immature insects exposed and so killed. This is laborious and not very practicable. As the incidence of attacks is directly correlated with light, it is possible to grow the plants under sufficient shade to keep down the infeststion to low proportions. Seedlings under light shade in the forest are fairly free from gall.

Chlorophora excelsa seed was sown at Navrongo in the Northern Territorities in 1939, and plants raised. Up to 1952, no gall attacks had been observed. The nearest C. excelsa trees are some 250 miles to the south.

FIELD NOTES. The bole may be mistaken for Morus mesozygia. The main point of difference is found in the latex, which is not sticky in Morus, or perhaps only slightly.

The seedling may be confused with that of Trema guineensis while both are very young. Trema is tri-nerved from the base of the leaf whereas Chlorophora is not. Also, the stipules on Chlorophora are slightly longer.

(ii) Chlorophora regia A.Chev.

Specimens of this tree have been found in the Gold Coast, but are not confined to any one particular area. To all appearances the tree is the same as C. excelsa; it is not separated from this species by the natives.

Aubréville (3) states that C. regia is endemic in the Cassamance, and that C. excelsa is not found there. Both species occur in the Ivory Coast, with C. excelsa the more frequent. In the Gold Coast C. regia may be considered rare.

Some of the points of difference noted by Aubreville (1) are as follows:

A. C. regia has a yellow wood which is less dense and less hard than the brown wood of C. excelsa.

B.

C. excelsa	Leaves.	C. regia.
More or less cordate.		Largely ovate.
15-18 pairs of yellow nerves, raised below.		6-10 pairs, raised below.
Soft to the touch below, sometimes velvety, always a very characteristic pubesence on the old leaves, very fine but very dense between the veins (visible with a strong glass).		Absolutely glabrous below (with the exception sometimes of some hairs on the nerves).
The veins somewhat raised and broad, forming a close reticulation.		Reticulation of the veins not prominent.

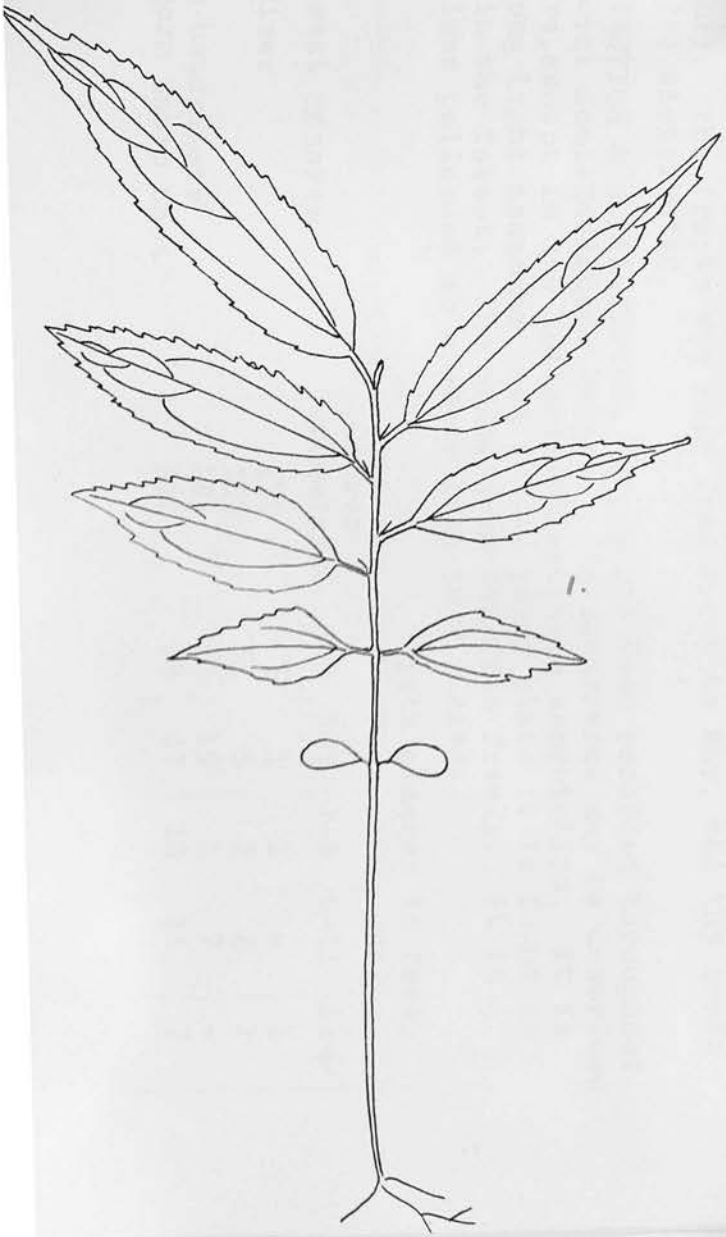
C.

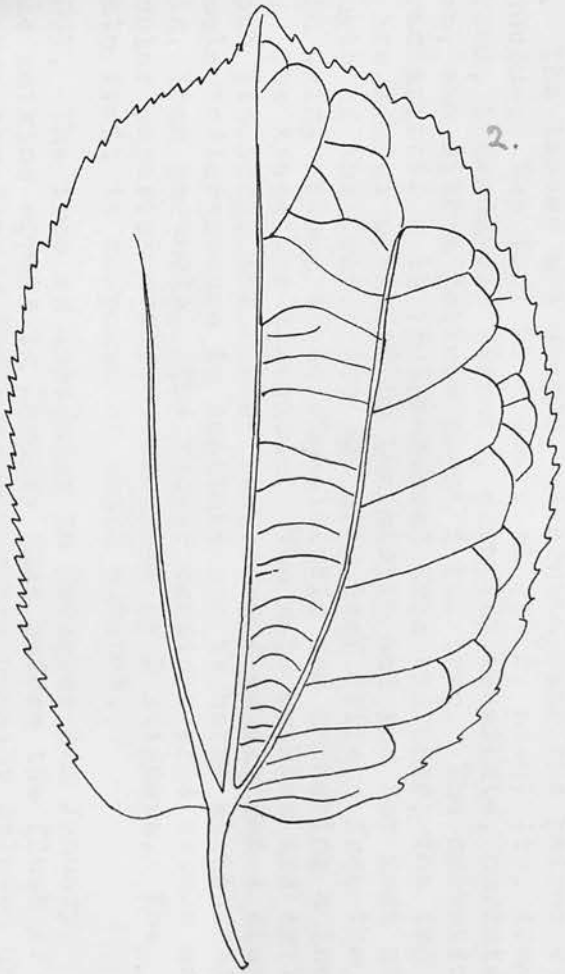
C. excelsa	Flowers.	C. regia
Calyx surrounded at the base by a dense ring of long, stiff hairs.		Only a few hairs or none.
Sepals oblong - 3mm. long.		Sepals ovate - 2mm. long.
Ovary substipitate, style slightly oblique.		Ovary sessile, style very oblique.

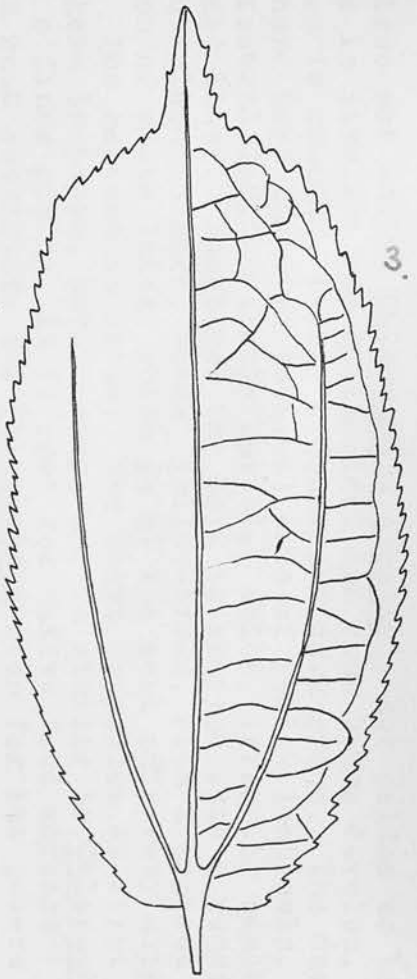
4. MORUS L.

Morus mesozygia Stapf

VERNACULAR NAMES. Kwae-odum (Ash). Odum-ngla (Ad). Wonton (Ash,T).







Morus mesozygia. 1.Seedling. 2.Leaf.
Both x 1. 3.Juvenile leaf x $\frac{1}{2}$.

A tree not unlike Chlorophora excelsa , but seldom as big. The bole is straight and cylindrical and root spurs develop. The crown is rounded, fairly compact and dark green. The dark brown, hard bark contains vertical rows of yellow lenticels. It is fissured longitudinally but big, thick, irregular scales are formed later. Sometimes the bark is greyish with a reddish hue. The slash is hard, thick, yellow-brown, with a copious exudation of white latex, which is at the most only very slightly sticky. The sapwood is white. The heart is yellow at first but darkens to brown, hard, heavy, and is similar to Chlorophora but has a finer grain. It is used for native food mortars and is a good substitute for Chlorophora even for its powers of resistance to termites and fungi.

BOTANY. The leaves are simple, alternate, and the paired stipules are caducous. The leaf is broadly elliptic, about 4in. long and 3in. broad, irregularly serrate, abruptly acuminate, cordate at the base, and with a petiole about ¾ in. long. The nervation is characteristic - it is tri-nerved from the base; the two lateral nerves are almost parallel to the midrib and run for most of the length of the leaf. The juvenile leaf differs from the adult in being oblong to oblong-elliptic and in having a longer acumen. The trees are dioecious. The male catkins are axillary, and about ¾in.long; the flower comprised 4 sepals and 4 stamens. The female inflorescence is capitate and is borne at the end of a ¾in. long peduncle. The flower consists of 4 sepals and a 2-locular superior ovary, surmounted by 2 stigmata. The aggregate fruit is composed of small achenes.

PHENOLOGY. The tree is deciduous in December and January. The male catkins appear in January just before the flush of new leaves, but the female inflorescences are usually delayed until February. The fruits are ripe from March to May, and the seeds are bird distributed.

DISTRIBUTION & SILVICULTURE. Morus has been recorded throughout the Moist Semi-Deciduous Forest. Its occurrence may be described as rare,except in the Antiaris-Chlorophora Association. It is a strong light demander, and in the young state it is found in gaps in the forest. The young tree coppices freely. It is sometimes pollarded as a shade tree in villages.

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Oda River	436	3	1	1	-	1
Ayum	306	30	8	2	2	1
Afram headwaters	185	53	19	5	2	-
Northern Scarp East	352	88	47	18	14	7

SEEDLING. Germination is epigeal. The slender, woody hypocotyl is about 1¾in. long, but often shorter. The small cotyledons are spatulate, about 0.3in. long and 0.15in. broad, rounded, and with a short, very slender petiole. The first two leaves are simple, opposite, and about ½in. above the cotyledons. The remaining leaves are alternate. The 6th. leaf is lanceolate, about 2½in. long and 0.6in. broad, serrate, acuminate and mucronate, rounded at the base and with a slender petiole about 0.2in. long. The leaf is tre-nerved from the base; the nerves are yellow on the underside. The paired stipules are short, narrowly triangular and caducous. All parts of the seedling are pubescent, but only sparsely so on the leaves.

NATURAL REGENERATION. This is uncommon, but is sometimes seen in the forest where there is sufficient overhead light. The young seedlings are delicate at first, but make good progress when conditions are suitable. Like Chlorophora it does not regenerate in Secondary Forest where the competition from shrubs and climbers is too great. This species avoids badly drained areas.

ARTIFICIAL REGENERATION. The germination period is about 18 days. A height of 5ft.7in. is recorded in the first year from a nursery where the beds were not shaded.

FIELD NOTES. See Chlorophora excelsa.

The young seedling may be confused with that of Trema guineensis. The leaf of Morus is narrower and the two basal lateral nerves are more prominent and almost parallel with the midrib.

5. MUSANGA R.Br.

Musanga cecropioides R.Br.

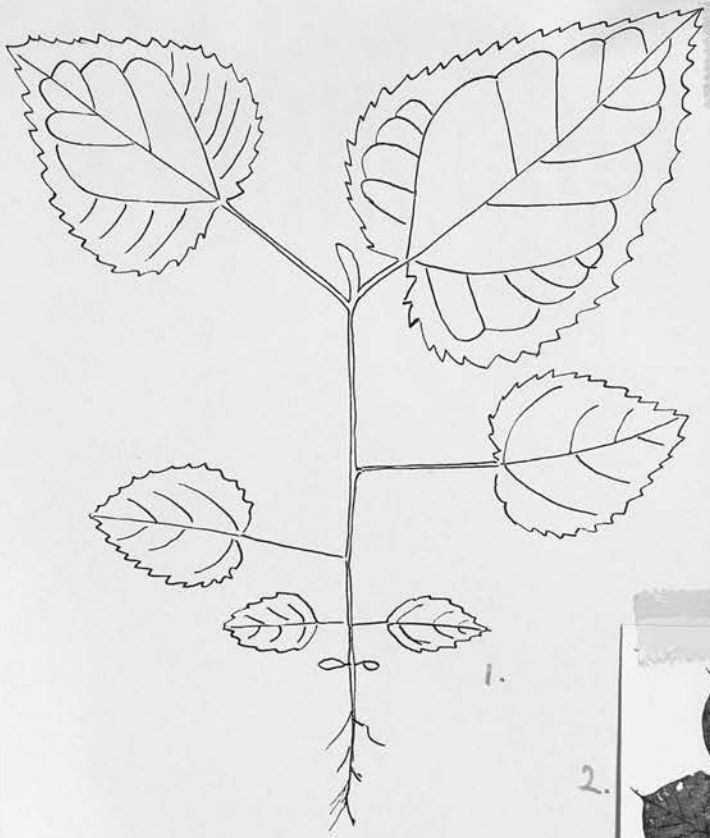
SYNONYM. M. smithii R.Br.

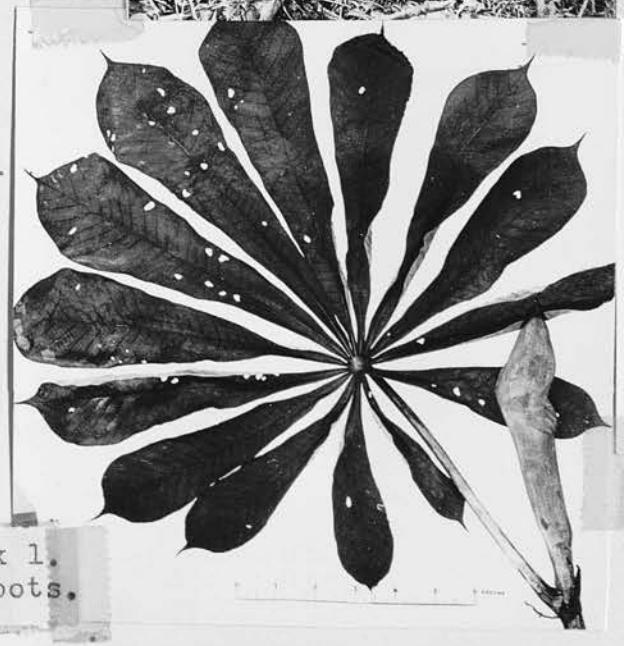
VERNACULAR NAMES. Egui (Ao,S). Egunli (Nz). Odwuma (Ash,F,T,W). Commonly called the Umbrella Tree an account of its shape.

A very quick growing tree which may attain a height of 60ft., but usually lees, and a girth of 4ft.-5ft. The stem is cylindrical and often quite slender. Stilt roots are a character

The outer bark is light grey and thin, with a green layer below. The slash is layered - a light grey, thin, outer bark, then a green layer, next a white one followed by a pinky layer and the white again. It becomes brown on exposure. Droplets of red-brown juice exude from the outer part of the slash.

The bole is almost smooth, and leaf and stipular scars are prominent on the younger wood. The white sapwood has a slight sheen. The heart is also white, and is light, varying from





Musanga cecropioides. 1.Seedling x 1.
2.Leaf. 3.Male flowers. 4.Stilt roots.

12-25 lb. per cu. ft., air dry, and soft. It is easily split. In transverse section, the vessels and numerous medullary rays are visible to the naked eye. The wood is used as fish net floats and as palings around farms. It is surprising how durable it is when used as palings.

BOTANY. The leaves are alternate and digitate. The two stipules are rather remarkable. They are about 8in. long, fused together, pointed at the apex, dull red and very pubescent on the outside. They entirely sheath the bud, but are caducous. On the inside they are white and silky. The leaf is digitate and may consist of up to about 14 leaflets. The leaflet is oblanceolate, up to 9in. long, entire, but may be finely serrate near the apex, cuspidate, attenuated at the base and sessile. The midrib and nerves are brown and raised below. The underside of the leaflet is silver grey and the upper glaucous green. There are sparse hairs on both sides of the lamina but they tend to disappear. The petiole is about 8in. long and covered at first with a purplish indumentum. The trees are dioecious. The male inflorescence is a panicle of globose heads, each about ¼in. diameter, and consisting of small flowers. A flower comprises a reduced perianth, a single exserted stamen and bracts. The female inflorescence is oblong, and is made up of flowers with a reduced perianth and an ovary. The fruit is oblong, somewhat flattened, up to 4in. long and 2in. diameter, and succulent.

PHENOLOGY. Musanga is evergreen. There is seldom a time in the year when some flowers and fruits are not to be seen.. The main flowering periods are May to September and December-January, with the corresponding fruiting periods of August-October and February-March. Flowers and fruits are abundant. The fruits are eaten by birds and the small seeds are distributed very efficiently.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone. It is a strong light demander, readily cleans itself of its lower branches, and is gregarious to a degree seldom seen in the Gold Coast except among the mangroves and with Trema guineensis. Musanga is a rapid coloniser, but only in forest clearings. It will not populate an area cleared after a scrub fallow. Nor will it follow itself for a second rotation on the same area. Wherever found, it is an even-aged crop. It grows rapidly and is a short lived tree. Its life span is not known accurately, but it is likely to be around 15-20 years, although local conditions may vary this. It does coppice, but an experiment in the Subri F.R. to see if a coppice rotation were practicable failed.

Silviculturally, Musanga can be useful, or a nuisance in young plantations and natural regeneration areas. If it has to be got rid of, this can be done either by girdling the stem above the stilt roots, or by frill girdling and pouring in a water solution of sodium arsenite. On the otherhand, Musanga is being a useful nurse over Lophira procera and Tarrietia utilis

natural regeneration in the Subri F.R.. Nine years after the area had been exploited, the Musanga, although plentiful, is apparently not retarding the growth of these trees which are also the result of the area having been opened up during timber felling operations. In a few cases, some of the Musanga are dying.

SEEDLING. Germination is epigeal. The hypocotyl is very short. The cotyledons expand. The first two leaves are opposite and immediately above the cotyledons. They are simple, ovate, about 0.4in. long and 0.3in. broad, acuminate, cordate, coarsely serrate, with a slender petiole and stipulate. The underside of the lamina is covered with a silvery indumentum and the upper side is weakly pilose. The succeeding leaves are alternate. They graduate in shape from cordate to palmate to digitate. The palmate leaves are serrate, and the leaflets of the digitate leaves are only serrate near the apex. The stem is dark brown and is covered with a thick mat of white hairs.

NATURAL REGENERATION. This is prolific, especially in openings and clearings in the forest. It does not occur under Musanga trees nor on denuded land. Growth is rapid if there is full overhead light, and a height of 6-8 ft. in the first year is normal. Musanga natural regeneration in the Subri F.R. had reached a height of 65 ft. and 2-4 ft. G.B.H. in 9 years. It is a tree which is remarkably free from climbers, and cases of it being smothered or strangled are rare. Invariably it is an even-aged crop. Individual trees are less usual than the gregarious crop. Where Musanga is a weed, it can best be got rid of in the seedling stage by pulling up the plants rather than cutting them. The latter method causes coppicing. Thus advantage should be taken in silvicultural operations of young Musanga not being firm rooted.

ARTIFICIAL REGENERATION. There are about 24,000 seeds to an ounce. So far, attempts to raise seedlings in the Gold Coast by artificial means have failed. W.Kesler (27) has obtained success in the Belgian Congo, and he advocates the following procedure:

1. Use fresh fruits and break down without using water.
2. Throw away the fibrous tissue from the centre of the fruit.
3. Mix with wood charcoal and cover lightly in a bed, and shade on sunny days.

Germination is said to take place in 14 days.

6. TRECULIA Decne.

Treculia africana Decne.

VERNACULAR NAMES. Brebretim (Ash,T,W). Otetim (Ash,T). Wunu (E).

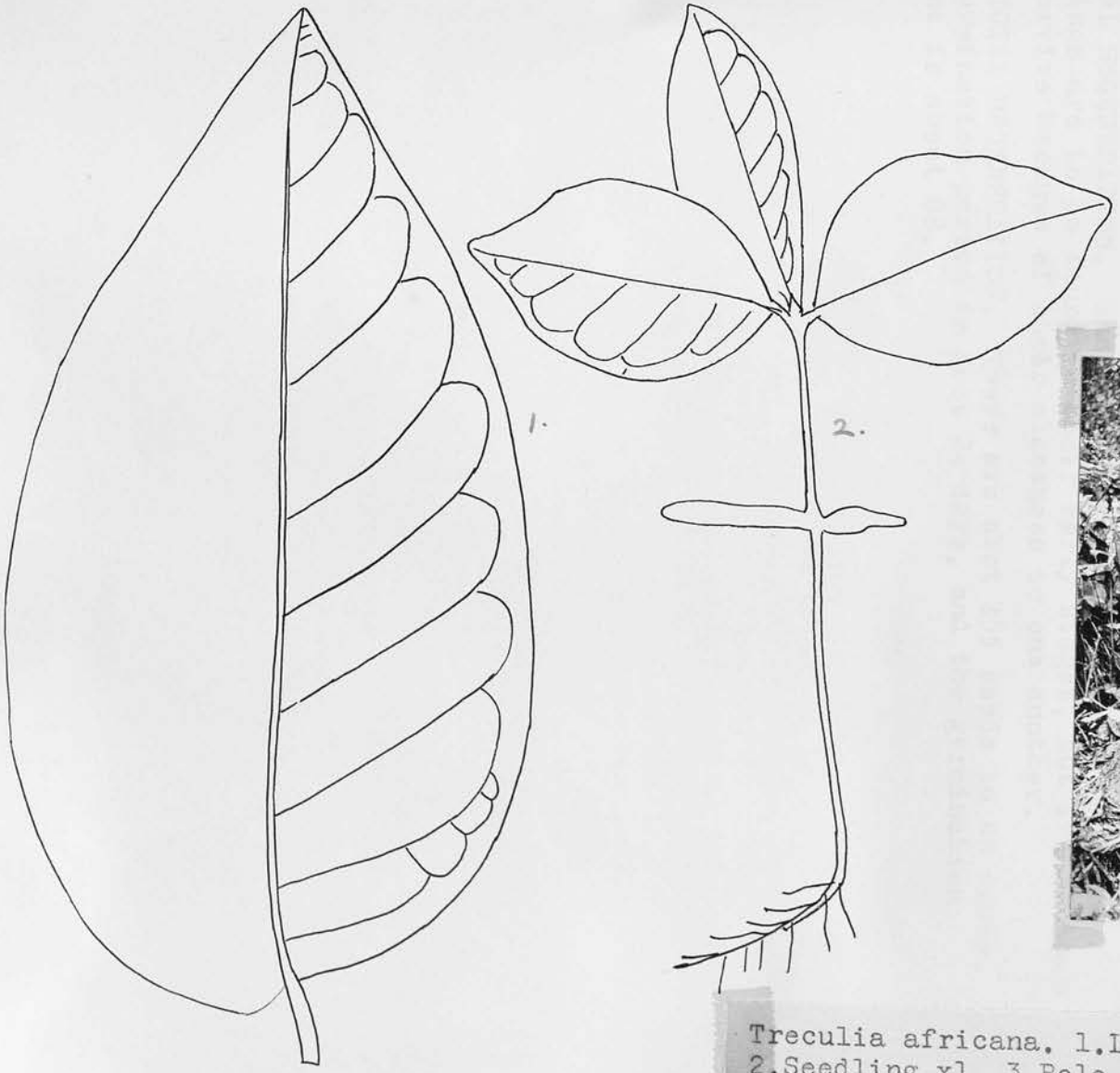
The first two names are also applied to Omphalocarpum. Confusion exists between these two genera as both have large fruits and exude a milky latex from wounds. Properly it seems that Brebretim should be used for Omphalocarpum and Otetim for Treculia. Otetim means "it drops" - a reference to the falling of the heavy fruit.

Sometimes known as the African Bread Fruit Tree on account of the similarity between it and Artocarpus incisa L., the Bread Fruit Tree.

A tree of up to 90 ft. high, but often smaller. The bole is slender, usually fluted and buttressed. The crown is small and rounded, and the branches are short and thin. The large leaves lie horizontally. The bark is smooth, grey and thin. The slash is fairly hard, moderately thick and pinkish-brown. A copious latex, the colour of milky tea, exudes from the slash; it is not sticky. The sapwood is white and the heart yellow to light brown and moderately hard. In transverse section, the medullary rays are numerous and conspicuous. With a hand lens can be seen the few very small vessels and the parenchyma extending laterally for a short distance from the vessels.

BOTANY. The simple leaves are alternate, and the stipules are caducous. The leaf is ovate-elliptic, about 6in. long and 3in. broad, or up to twice this size, entire but sometimes undulate. acute, sub-cordate and unequal at the base, coriaceous, glossy above, glabrous and with the midrib and nerves raised below. The petiole is stout, about ½ in. long, black and flattened above. The branchlets are grey to black and the buds are pointed. The tree is monoecious. The male inflorescence is axillary and consists of an ellipsoid mass about 1½ in. long, with the flowers inserted in the perimeter. The flower consists of a reduced calyx and 2-3 protruding stamens. The female inflorescence is also axillary, and globose. The ovaries are embedded but the bifid styles are visible on th outside. The infructescence is cauliflorous, spherical, from 6-12 in. diameter, yellow when ripe and with numerous small edible seeds.

PHENOLOGHY. The tree is evergreen. New leaves flush red. Flowering takes place in July and August. Ripe fruits are available in December, but they may persist on the tree till July. Eventually they fall to the ground and are eaten by small animals which help in distributing the seed. As the latter is edible, much of it must be destroyed in the actual eating.



Treculia africana. 1.Leaf x 2/3.
2.Seedling xl. 3.Bole.

DISTRIBURION & SILVICULTURE. The tree is never common and is scattered throughout the High Forest. It is generally found in wet situations, where the soil is heavy and capable of retaining water, and near streams.

SEEDLING. Germination is epigeal. The hypocotyl is about 2in. long. The narrow fleshy cotyledons are curious in that one is about lin. long and the $\frac{1}{2}$in. The first two leaves are borne about $1\frac{1}{4}$in. above the cotyledons and are opposite. The leaf is simple, ovate, about $1\frac{3}{4}$ in. long and $1\frac{1}{4}$ in. broad, with an undulate margin, broadly acuminate, rounded at the base, dark green above, light green below, glabrous and with a very short petiole. The succeeding leaves are alternate and simple. The 3rd. leaf is oblong-lanceolate to broadly oblanceolate, acute, with a broadly cuneate base, and with the midrib and nerves raised below. The stem is blackish-brown and woody.

NATURAL REGENERATION. Where the fruits have fallen, many seedlings are to be found in their early stages, but few of them can survive because of their closeness to one another.

ARTIFICIAL REGENERATION. There are abot 155 seeds to an ounce. The germination period is abot 22 days, and the germination percent is about 88.

5. Leaves & fruits. b. Tree.

MYRISTICACEAE.

A family of woody plants with evergreen leaves which are simple, alternate and exstipulate. The flowers are unisexual and usually trimerous. The superior ovary is unilocular and has one ovule. The fruit is dehiscent and the seed is conspicuously arillate. This family contains the nutmeg tree - Myristica fragrans Houtt. - a native of the East Indies.

Besides the genus described below, there also occurs in the Gold Coast Coelocaryon oxycarpum Stapf, a tall slender boled tree, not frequently seen.

PYCNANTHUS. Warb.

Pycnanthus angolensis (Welw.) Exell.

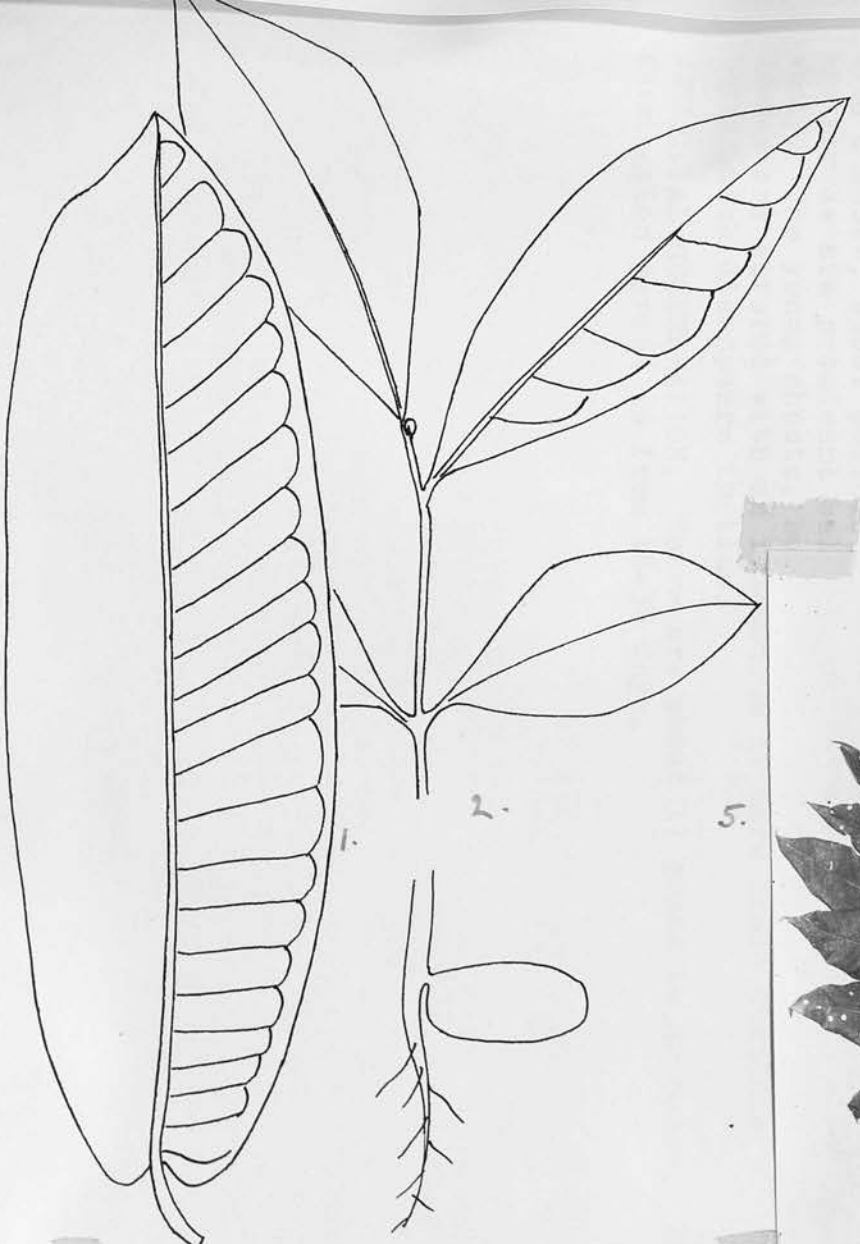
SYNONYM. P. kombo (Baill.) Warb.

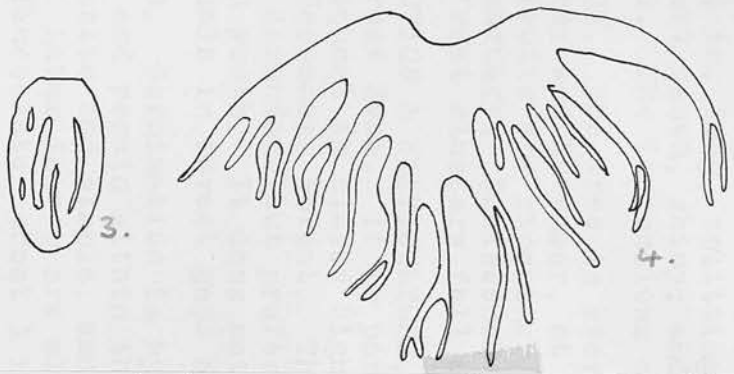
VERNACULAR NAMES. Atenli (Ao). Etsi (F). Otie (Ash,S,T,W). Tika (Nz).

TRADE NAME. Pycnanthus.

A medium sized tree of about 120 ft. high but with a girth B.H. which may reach 12 ft. The bole is typically tall and cylindrical with often a marked taper. There are no buttresses, except for short small ones in very old trees. The crown is fairly large, tending to be flattened on top, and composed of slender branches which may be horizontal or ascending, but droop atthe ends. The leaves present a diagnostic feature as they are always riddled with insect holes on trees beyond the sapling stage. The bark is brown, often dark, with irregular, vertical scales, and becomes shaggy. The slash is thick, pinkish-brown, with a copious, strawberry coloured exudation. The wood is greyish-brown, but with a pinkish tinge when fresh, light, 26-32 lb. per cu. ft. at 15% moisture content, soft, straight grained but coarse. It is not durable and is very liable to stain, but absorbs preservatives readily. In transverse section the small scattered vessels are just visible. In longitudinal section the narrow, long vessels are conspicuous. The wood slpits quite readily and it has been used for second rate roofing shingles.

BOTANY. The leaves are simple, alternate and exstipulate, and are riddles with insecr holes. The leaf is oblong, 6 in. long and 2 in. broad, or bigger, entire, acuminate, cordate, coriaceous, dark green above and covered with a dense, rusty indumentum of stellate hairs - these disappear in time. The petiole is about ½ in. long. The midrib and the looped nerves are raised below. The tree is monoecious, with the asexual flowers on different parts of the same branch. The male panicles are rufous coloured and consist of small globose heads. There are 3 sepals, no petals and usually 3 stamens. The female





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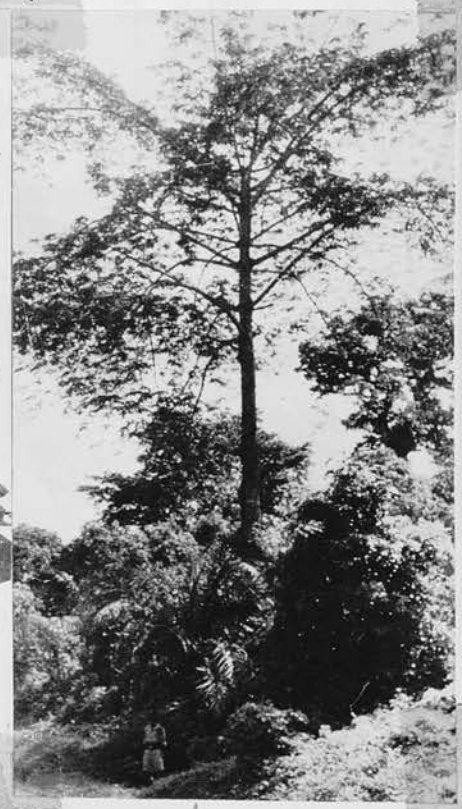


Pycnanthus angolensis. 1.Leaf.
2.Seedling. 3.Seed. 4.Aril. All x 1.
5.Leaves & fruits. 6.Tree.

panicles are similar but with fewer flowers. There are 3 sepals, no petals, and a unilocular ovary surmounted by two sessile stigmata. The fruit is a woody, oblong, two valved capsule, about 1¼ in. long, splitting longitudinally. The single seed is hard, dark brown, shiny, and is surmounted by a red, deeply cut aril. The impressions of the aril can be seen on the testa.

PHENOLOGY. The tree is evergreen. The flowers are produced in October and November, at the same time that the previous year's fruits are ripening. The fruits remain on the tree until about February. Dehiscence takes place on the tree, but many of the fruit clusters fall unopened.

DISTRIBUTION & SILVICULTURE. Pycnanthus is found throughout the High Forest Zone. It is particularly common in Secondary Forest. When frequent in closed High Forest it is usually an indicator of Old Secondary Forest. The young plant grows rapidly. It is a light demander, but prefers partial although not too heavy shade in youth. It does not colonise in quantity but occurs as individuals in forest gaps and clearings.

SEEDLING. Germination is hypogeal. The cotyledons do not develop and remain within the seed coat. The first two leaves are opposite and simple, and are borne about 4 in. above the ground. Later leaves are alternate. The third leaf is simple, oblong-lanceolate, about 3 in. long and 1 in. broad, entire, acuminate, cuneate, dark, shiny green above and dull below, with a short, stout petiole about 0.2 in. long. The midrib and nerves are prominent below. The stem is dark brown and woody. The young shoots, buds, petioles and undersides of the leaves are covered with an indumentum of dark brown stellate hairs which disappears in time.

ARTIFICIAL REGENERATION. There are about 17 seeds to an ounce. The germination period is from 16-36 days.

OCHNACEAE.

A family of trees and shrubs, with alternate, simple, stipulate leaves. The flowers are usually petamerous but the stamens are often numerous. The ovary is superior and consists of 2-10 loculi. The fruit is often a drupe or nut. The carpels usually separate in the fruit and are subtended by the persistent sepals.

Species of Ochna Schreb. and Ouratea Aubl. are common.

LOPHIRA Banks

There are two species which were formerly lumped together as one, with a variety. The small tree of the Savannah-Woodland is now accepted as Lophira alata Banks.

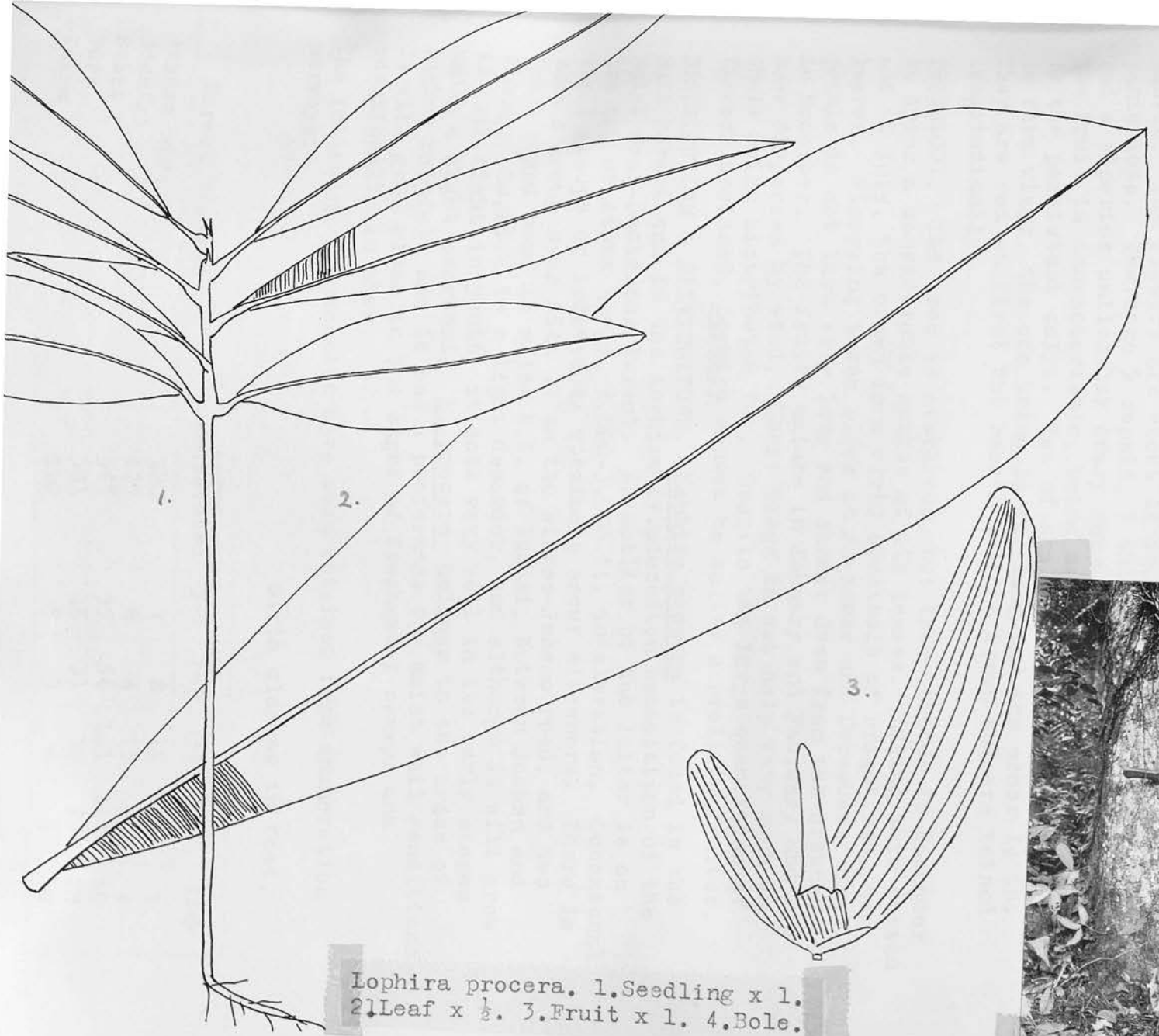
Lophira procera A.Chev.

SYNONYMS. L. alata Banks var. procera Burtt Davy. L. barteri, L. lanceolate, L. macrophylla, L. spatulata, L. thollonii, all of Van Tiegh.

VERNACULAR NAMES. Assore (Ao). Azobe (Nz). Kaku (W).

TRADE NAME. Ekki.

A tall tree of about 150-180 ft. and a girth of 15 ft. The bole is reasonably straight but not always cylindrical. Usually there are no buttresses but small ones may develop in old trees. The crown is not very large but the branches are heavy. The leaves are tufted towards the ends of the branches and the foliage is not dense. The bark is golden brown and irregularly scaly. The slash is liver-red and hard, and the sapwood white to light brown. The heart is very dark brown, very heavy, about 60 lb. per cu. ft. at 15% moisture content, very hard and very durable. It is resistant to fungi, insects and marine borers. The wood has an interlocked grain, is fairly coarse and open, and does not work easily. In transverse section a few scattered vessels are visible, and also many, narrow, continuous bands of parenchyma unrelated to the vessels. With a hand lens, the very numerous, fine medullary rays can be seen. The long vessels are prominent in longitudinal section. The wood would be more popular than it is if it were not for its hardness and heaviness. It has been used for harbour piles, fenders and walings, for railway sleepers and for shaft guides in underground structures in mines. It is a good firewood. Because of its high electrical resistance it is used for switchboards.



Lophira procera. 1.Seedling x 1.
2.Leaf x ½. 3.Fruit x 1. 4.Bole.

BOTANY. The leaves are simple, alternate, strap-like, with small caducous stipules. The leaf is oblong-lanceolate, about 9 in. long and 3 in. broad, but as much as 36 in. long in young plants. It is entire, obtuse or rounded or almost apiculate or sometimes emarginate, cuneate, shiny and glabrous. The petiole is short and thick. The midrib is raised below. The nerves are very fine, numerous and more or less at right angles to the midrib. The flowers are about 1½ in. diameter, scented and paniculate. Thereare 5 sepals, 5 white petals, numerous stamens and a superior unilocular ovary surmounted by two stigmata. The fruit is characteristic, being an elongated nut, subtended by the persistent calyx. Two of the sepals enlarge unequally to form wings, the one being 3½ in. long and the other 1½ in. They are red at first but become a light brown and are veined longitudinally.

PHENOLOGY. The tree is evergreen, but from October to December it drops a considerable number of its leaves. During this period and in July, the crown is a vivid spectacle of bright red, new leaves. Flowering takes place in November and December. The petals do not last very long and shower down from the crowns in December. The fruits mature in January and February and are soon dispersed by wind. Their wings do not help very much in their being distributed far. Despite the large quantities of flowers produced, Lophira cannot be called a prolific fruiter.

DISTRIBUTION & SILVICULTURE. Lophira procera is found in the Rain Forest and in the Lophira-Triplachiton Association of the Moist Semi-Deciduous Forest. An outlier of the latter is on the top of Atewa Range, 1,000-3,000 ft. in elevation. Occasional small groups or individual specimens occur elsewhere. There is such a group near Mile 77 on the Wiawso-Jabeso road, and two trees stand some 16 miles N.E. of Kumasi, between Juaben and Ntonso. Lophira is a light demander, and although it will grow in full light in youth, it does very well in its early stages under a light overwood. L. procera belongs to the areas of higher rainfall and it has a preference for moist soil conditions. It will grow close to the edges of freshwater swamps and occasionally in them.

The following frequencies have been obtained from enumeration surveys:-

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Ankasa River	120	7	8	15	11	5
Ndumfri	175	6	4	15	13	4
Subri	965	55	56	101	114	60
Fure	381	16	31	38	49	23
Kakum	150	9	3	8	2	9

SEEDLING. Germination is hypogeal. The stem is woody and shiny brown. The first two leaves are simple, opposite and about 4 in. above ground. The remaining leaves are arranged spirally. The 4th.leaf is simple, lanceolate, about 4 in. long and $\frac{3}{4}$ in. broad, entire, acuminate, attenuated at the base, glossy green above and less glossy green below, and glabrous. The petiole base is very prominently swollen on the underside. The nerves are numerous, fine and more or less at right angles to the midrib. The young leaf has a red flush. The paired caducous stipules are triangular, about 0.2 in. long, with a long tip.

NATURAL REGENERATION. This is usually found in groups near the mother tree. The best regeneration is where the soil is moist but with good drainage, and where the overhead canopy is fairly light. Seedlings are to be found in seasonal swamps, and occasionally in freshwater swamps, but seldom in quantity in such places. Where light conditions are suitable, growth is rapid. An area in the Subri F.R. was opened up considerable in 1943-45 for obtaining pitsawn timber and poles. The resulting Lophira regeneration came up with a crop of Musanga cecropioides. In 1952 the Lophira was 21-30 ft. high and the Musanga overwood some 20-30 ft. higher and doing no harm to the Lophira, although the height increment is probably a little less than it would be in the open. There are signs of the Musanga beginning to die (1952).

The following height measurements are of seedlings in Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year.
5in.	9in.	24in.	44in.
9	20	63	93
7	16	42	77
11	26	76	124
9	19	34	62
7	11	14	20

ARTIFICIAL REGENERATION. There are about 120 seeds to a pound. The seed does not retain its viability for long. The germination period is 9-16 days and 88% germination may be expected. The plants are about 11 in. high at 6 months, and 2 ft. 4 in. at 1 year. 3 year old nursery stock measured between 6 ft. 2 in. and 14 ft. in height. Seedlings are suitable for planting out at 18 months, and do well as stripped plants under a high, light shade at first, and then the canopy opened further when the plants are properly established. The long taproot must be pruned before transplanting. So far, planting in swamps has proved a failure as the root dies quickly.

PATHOLOGY. When the young plant is growing in full light, it is subject to borer attack in the leading shoot. The insect (Not yet identified) enters the base of the terminal bud and bores down through the shoot, causing it to die. The lateral buds become active and more than one shoot develops. Such attacks are more usual in the nursery than in the forest.

OLACACEAE.

A family of trees and shrubs and a few climbers. The leaves are alternate, simple and exstipulate. The flowers are small and hermaphrodite with a superior ovary, often unilocular, which may be sunk in a disc. The fruit is usually a globose drupe or nut, and the seed has endosperm. In the small High Forest trees Aptandra zenkeri Engl. and Heisteria parvifolia Sm., the calyx becomes enlarges and persistent in the fruit. Ximenia americana L. is a thorny shrub or small tree found in the Savannah-Woodland and Coastal Scrub and Grassland.

GENERA. 1. Coula Baill. 2. Ongokea Pierre 3. Strombosia Bl.

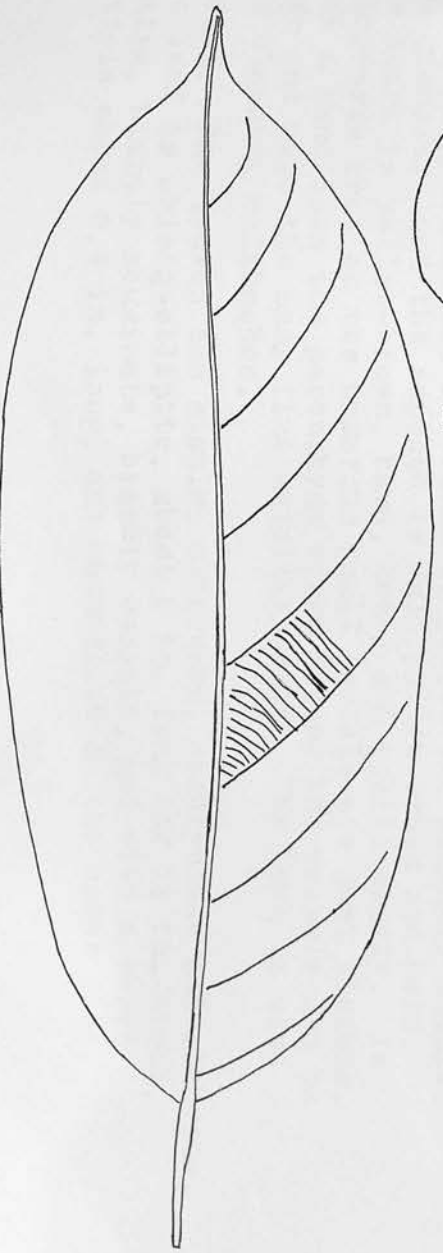
1. COULA Baill.

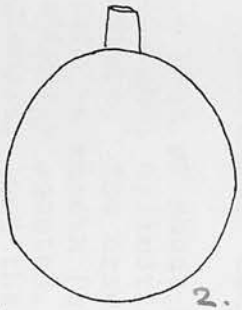
Coula edulis Baill.

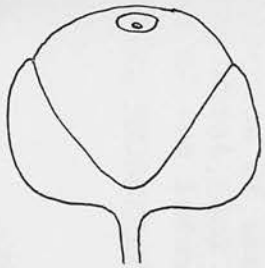
VERNACULAR NAME. Bodwe (Ash,Nz,T,W). This name is also applied to Ongokea.

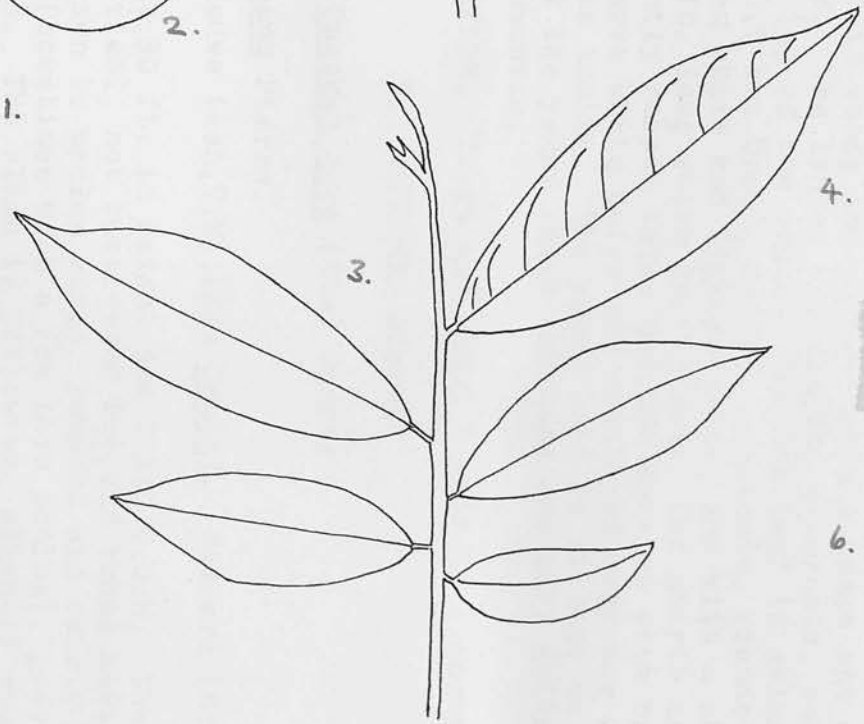
A medium sized tree of about 90 ft. high and 8 ft. G.B.H. The bole is often not very straight, and usually fairly short and not buttressed. The crown is dense and deep, and spreads whenever it gets the opportunity. There are irregular pustules on the bark, and the thin scales give it a shaggy appearance. The slash is thick, fibrous and dull saffron-brown,and a few pin points of white latex exude. The sapwood is dull brown and the heart reddish-brown. The wood is heavy, 66 lb. per cu. ft. at 12% moisture content, hard, strong and durable. It is said to be immune to termites. The kernels of the fruits are edible.

BOTANY. The leaves are simple, alternate and exstipulate. The leaf is oblong, about 6 in. long and 2¼ in. broad, entire, with the leaf margin curved over backwards, acuminate, almost rounded at the base, shiny dark green above and lighter below. There are rufous stellate hairs on the undersides of the leaf at first, but they soon disappear. The petiole is slender, about ¾ in. long, slightly swollen at the apex, channelled above, and slightly pubescent. The midrib and nerves are raised below. The nerves are not looped. The veins are very fine and are more or less parallel with one another. The flowers are small and racemose. The 5 sepals are reduced to a rim. The 5 petals are yellow green, and there are 15 stamens. The superior ovary is usually 3-locular. The fruit is a globose drupe, about 1½ in. diameter, almost plum red in colour and shiny. The mesocarp is quite thick. The endocarp is very hard and contains an edible seed.









Coula edulis. 1.Leaf. 2.Fruit.
3.Seedling. All x 1. 4.Bole.
Ongokea gore. 5.Fruit x 1. 6.Bole.

PHENOLOGY. The tree is evergreen. Flowering takes place from April to June, and the fruits are available from August to January. They are usually to be found under the mother trees.

DISTRIBUTION & SILVICULTURE. Coula has its main distribution in the Rain Forest and the adjoining Lophira-Triplochiton Association, although occasional trees may be found elsewhere in the High Forest.. It is a moderate shade bearer, and normally a constituent of the upper reaches of the lower storey, but is also found in the upper canopy. It is often semi-gregarious and does not appear to be very selective about sites, as it is found on a fairly steep hillside in the Subri F.R. and along the Bonsa River in low lying land. Although locally frequent, it is not a common tree.

SEEDLING. The stem is woody and covered with a dense mat of brown villose hairs. The leaves are simple, alternate, and increase in size toward the top of the shoot. The 5th. leaf is oblanceolate, about 3 in. long, 0.8 in. broad, entire, acuminate, rounded at the base, dull green above and lighter below, and with a short petiole about 0.1 in. long which is villose. The midrib and nerves are prominently raised below and are covered with brown, villous hairs. Sparse white hairs are scattered over the rest of the underside of the lamina. The young leaf is villous on both sides at first, and the young shoot and buds are dull golden brown because of the indumentum.

ARTIFICIAL REGENERATION. There are about 6 nuts to 1 ounce.

2. ONGOKEA Pierre

Ongokea gore (Hua) Pierre

SYNONYM. O. klaineana Pierre.

VERNACULAR NAME. Bodwe (Ash,T,W).(See Coula). Bodwera (Nz).

A tree of about 90 ft. in height and 7 ft. G.B.H. The bole is straight, cylindrical, not buttressed but old trees have short root spurs. The crown is medium sized, rounded and fairly dense. The bark is smooth (sometimes with a few thin scales), grey-brown and slightly scented. The slash is yellowisn, slightly scented and granular, and the sapwood is dull yellow-brown and hard. The heart is yellow-brown, hard, heavy and splits easily. In transverse section the numerous small vessels are just visible. With a hand lens the parenchyma rings around the vessels can be seen and also the many fine medullary rays. The bark is used for cleaning calabashes.

BOTANY. The leaves are simple, alternate, exstipulate and glabrous. The leaf is oblong-elliptic, about 2 in. long and 1½ in. broad, entire, bluntly acuminate, broadly cuneate, and with a short petiole about 0.4 in. long, and channelled on the upper side.

The small flowers are in axillary cymes. The flower is 4-merous, with the stamens in a tube. The superior ovary is unilocular. The fruit is a yellow, globose drupe, about 1 in. diameter. The green calyx develops, almost enclosing the fruit, and splits into 2 or 3 when ripe. The kernel is bitter and not edible.

PHENOLOGY. The tree is evergreen. Flowering takes place between April and June, and fruits are available from April to November. When ripe they drop to the ground and are eaten by animals.

DISTRIBUTION & SILVICULTURE. Ongokea is found throughout the High Forest. It is scattered and its occurrence may be described as rare. It is a tree of the upper canopy, but does not become dominant.

ARTIFICIAL REGENERATION. There are about 5 seeds to an ounce. The germinating seeds are liable to be eaten by rodents. Germination is delayed. It does not usually begin before 6 weeks and may go on for a year.

FIELD NOTES. Coula and Ongokea are liable to be confused. They are not separated by the natives who use the same name Bodwe for both. Principal points of difference are as follows:

Character	Coula	Ongokea
Slash	Saffron brown	Yellow
Latex	Pin points	None
Leaf	6 in. long, sharply acuminate, pubescent at first.	2 in. long, bluntly acuminate, glabrous.
Nerves	Not looped	Looped
Fruit	Nut	Yellow drupe
Calyx	Not developing in the fruit	Developing in the fruit.
Kernel	Edible	Bitter - not edible.

3. STROMBOSIA Bl.

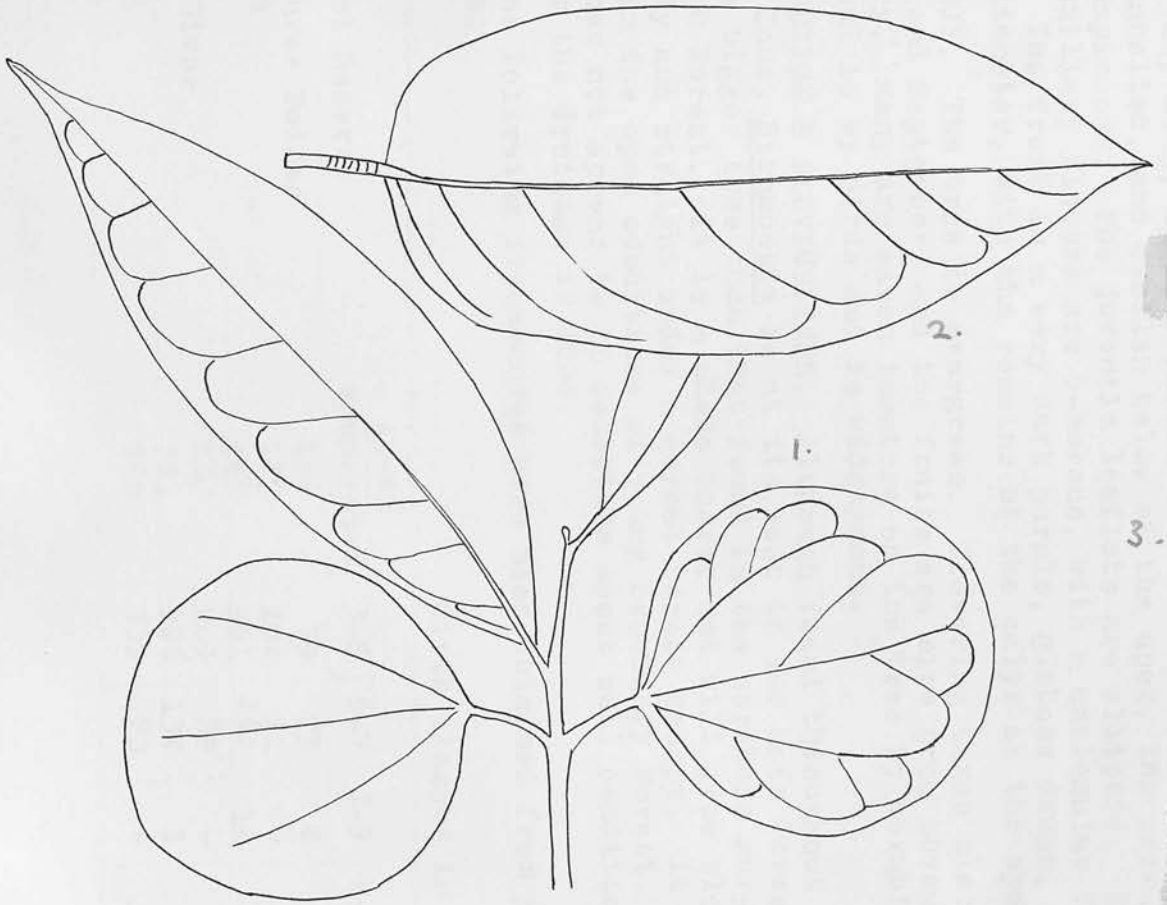
Strombosia pustulata Oliv.

VERNACULAR NAMES. Afina (Ash,T,W). Efenka (S). Flanga (Nz). Omenam (Ash).

TRADE NAME. Afina.

A medium sized tree of about 80 ft. height and 6 ft. G.B.H. Some felled trees gave the following measurements:

Girth breast height	Length of bole	Height of tree
4ft. 8in.	66ft. 0in.	94ft. 0in.
5 6	66 0	89 0
5 9	68 7	104 7



3.

Strombosia pustulata. 1.Seedling.
2.Leaf. Both x 1. 3.Bole.

The bole is slender, straight and without buttresses. The crown is small and rounded. The scaly bark peels, leaving light grey patches. This mottling gives the bole a characteristic appearance. The slash is thin, granular and dull yellow. The sapwood is yellowish. The heart is purplish-brown, heavy, about 62 lb. per cu. ft. at 15% moisture content, hard, with a fine texture and reasonably durable against termites. The fresh wood has a bad smell. Planks are liable to split on seasoning. With a hand lens can be seen many small vessels and numerous very narrow medullary rays, with irregular bands of parenchyma between them. The poles are used in native houses, as bridging material, underground in mines, and when treated with preservative for telegraph poles.

BOTANY. The leaves are simple, alternate, glabrous and exstipulate. The leaf is oblong, about 4 in. long and $1\frac{3}{4}$ in. broad, entire, acuminate, rounded at the base and dark green. The petiole is about $\frac{1}{2}$ in. long, dark, wrinkled near the apex, flattened above and channelled, and swollen below at the apex. The nervation is not conspicuous. The juvenile leaflets are elliptic. The very small axillary flowers are 5-merous, with a unilocular inferior ovary. The fruit is a very dark purple, globose drupe, about $\frac{3}{4}$ in. diameter, with the remains of the calyx at the apex.

PHENOLOGY. The tree is evergreen. Flowering takes place in August and September, and the fruits are ripe from November to February. Many are eaten immature on the tree by hornbills. Dispersal is by birds and is widespread.

DISTRIBUTION & SILVICULTURE. Although found throughout the High Forest Zone, Strombosia is at its best in the Rain Forest where it is a bigger tree than that found in the northern margin of the High Forest. It is a shade bearer and will grow slowly, steadily and straight under a normal forest canopy. It is not found in the open conditions of young Secondary Forest. This tree does not appear to be selective about soil conditions, as long as the drainage is free.

The following frequencies have been obtained from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Cape Three Points	129	79	25	6	-	-
Ndumfri	175	104	11	-	-	-
Subri	965	991	161	16	-	-
Bonsa River	160	209	29	-	-	-
Fure	381	526	134	1	-	-
Yoyo	569	335	20	-	-	-

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, dark green and glabrous. The cotyledons expand to become foliaceous, nerved, orbicular, about 2 in. diameter, dark green above and light green below, and with a petiole about ½ in. long, flattened and deeply channelled above. The primary leaves are simple, alternate, glabrous and exstipulate. The first leaf is ¼-½ in. above the cotyledons, oblong-lanceolate, about 4 in. long and 1¼ in. broad, or smaller, entire, acuminate, cuneate, dark green, and with a short petiole.

NATURAL REGENERATION. This is frequent, especially near the mother trees, but is well distributed. The partial canopy openings carried out under the Tropical Shelterwood System appear to be ideal for this species. Much regeneration is being obtained and growth is strong. The following seedling heights have been recorded in the Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
7in.	15in.	23in.	37in.
6	19	30	46
7	16	21	37
8	16	28	39
11	22	45	58
6	13	18	58

ARTIFICIAL REGENERATION. There are about 42 seeds to an ounce. Germination is irregular and varies from 16-30 days. Growth is slow and a height of only 6 in. may be rached in the first year. Screening of the nursery beds is desirable.

PAPILIONACEAE.

This large family contains numerous herbs, shrubs, small trees and climbers, not many large forest trees. The leaves are generally compound, but an exception is Baphia Afz. which has simple leaves. Stipules are present and sometimes stipellae as well. The flowers are rather characteristic and have given the name to the family (Latin papilio, a butterfly). The flowers are zygomorphic and often showy. There are 5 sepals, 5 petals, 10 stamens and a unilocular superior ovary. The petals consist of a large posterior standard, two lateral wings and two side ones more or less united to form the keel. The stamens may have 9 united into a tube. The fruit is a pod which may be dehiscent or not.

Included in this family are the small trees Lonchocarpus H.B.& K., Millettia Wight & Arn. and Pterocarpus L. Also Baphia Afz. - shrubs or small trees - and the common climbers Mucuna Adans.

GENERA. 1. Afrormosia Harms 2. Amphimas Pierre 3. Erythrina L.

1. AFRORMOSIA Harms

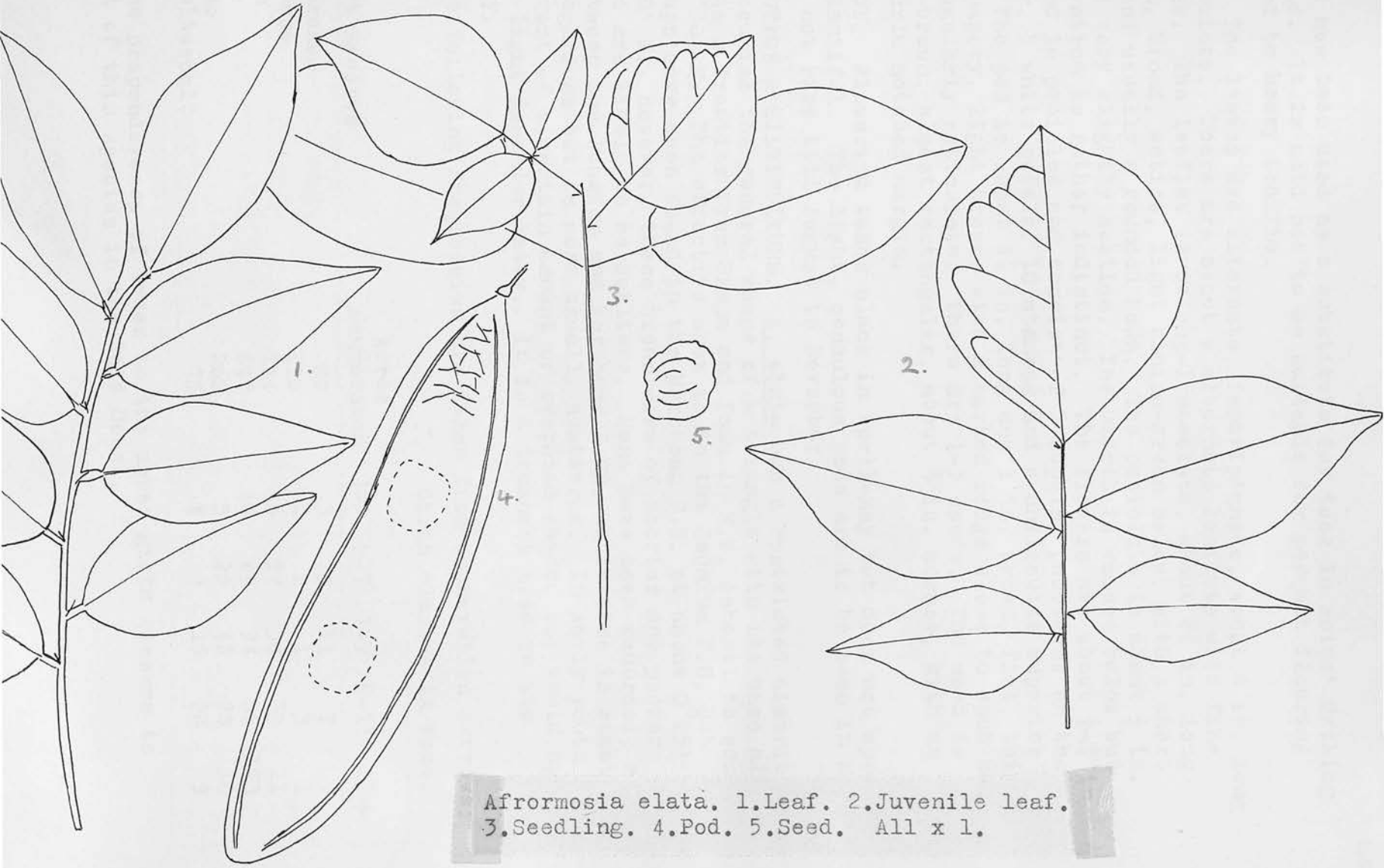
Afrormosia laxiflora Harms is a small tree of the Savannah-Woodland.

Afrormosia elata Harms

VERNACULAR NAMES. Awawei (Ash). Kokrodua (Ash)

TRADE NAME. Kokrodua.

A tall, dominant tree of the High Forest. A specimen felled near Mim (West ern Ashanti) had a girth of 10 ft. 10 in. measured above the buttresses, a bole length of 58 ft. 3 in. and a total height of 145 ft. 9 in. The bole is straight and not often exceeding 12 ft. girth. The base is fluted rather than buttresses. The bark is light coloured, but peels off in thin, irregular scales to leave dull rusty blotches which give the bole a diagnostic appearance. The slash is very thick; the outer layer is green and the remainder a pale yellow brown which soon discolours to dull red. The sapwood is light yellow-brown and shows ripple marks. The heart is dark brown, moderately hard and heavy, 44 lb. per cu. ft. at 15% moisture content, with a fine texture, reasonably durable, polishes and turns well. In some ways it is similar to teak, Tectona grandis L., but is not oily and has a finer texture. In transverse section, the small vessels and fine medullary rays can be seen, and also irregular, narrow bands of parenchyma, some of which are quite long. They almost give the appearance of continuous bands. In longitudinal section the numerous ripple marks are evident.



Afrormosia elata. 1.Leaf. 2.Juvenile leaf.
3.Seedling. 4.Pod. 5.Seed. All x 1.

The wood has been used as a substitute for teak in ships' decking and rails. It is said not to be suitable for parquet flooring subjected to heavy traffic.

BOTANY. The leaves are alternate, imparipinnate, about 6 in. long and stipulate. There are about 9 alternate leaflets with fine stipellae. The leaflet is oblong-lanceolate, about 2½ in. long and 1 in. broad, entire, light bluish-green below, with a short acumen and usually a rounded base. The petiolule is about ¼ in. long and very slightly swollen. The midrib is raised below but the nervation is rather indistinct. The flowers are about ½-¾ in. broad and in panicles and consist of 5 sepals, pubescent on the exterior, 5 white petals, 10 stamens and a unilocular superior ovary. The pod is about 4½ in. long and 1 in. broad, flat, thin, almost papery, light brown, with a marked ridge close to each margin and irregularly reticulate. There are 1-3 seeds. The seed is reddish-brown, almost rectangular, about ½ in. across, with an irregularlu notched margin.

PHENOLOGY. Flowering takes place in April-May but does not appear to be plentiful. The light, pendulous pods are to be seen in May, but are not ripe till August to November.

DISTRIBUTION & SILVICULTURE. A. elata has a restricted distribution which occupies the general shape of a triangle with its base along the western frontier from Sampa and Pamu in N.W. Ashanti to somewhere about 6° 30' N. The effective apex is in the Boumfum F.R. but two groups have been found in the Worobong F.R. at about 0° 25' W. and 6° 30' N. However, these trees were of shorter and poorer form and are likely to be outliers. None have been recorded, so far, between the Boumfum and Worobong F.Rs. This tree is sometimes semi-gregarious but is more usually scattered. In early youth it is tolerant of a certain amount of overhead shade, but would appear to be a light demander later. It is a dominant tree in its locality.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Pamu-Berekum	82	3	9	11	7	7
Tinte Bepo	110	-	2	1	3	1
Boumfum	154	16	27	30	30	11
Asukese	647	16	49	94	86	123
Bia Tano	262	5	25	45	28	10
Bia Shelterbelt	75	4	7	15	28	9

The preponderence of trees in the upper girth classes is typical of this species in the Gold Coast.

SEEDLING. Germination is epigeal and the cotyledons do not develop. The hypocotyl is about 2½ in. long. The first two leaves are borne about 2 in. above the cotyledons and are opposite, simple, elliptic, about 2½ in. long and almost 1½ in. broad, entire, acute, rounded at the base, with a fine petiole about ½ in. long and stipulate. The remaining leaves are alternate. The 3rd. leaf is simple, ovate, about 1¾ in. long and 1¼ in. broad, entire, acuminate, rounded at the base, with a fine, ½ in. long petiole, stipulate and with a fine stipella at the apex of the petiole. The 4th. leaf is usually trefoliate and the remainder of the juvenile leaves imparipinnate with often 2 pairs of alternate or sub-opposite, elliptic to oblong-elliptic leaflets and a larger terminal ovate one which may be almost orbicular. All have stipellae, less than 0.1 in. long, linear and very fine. The leaflet is dull green above and pale green or glaucous below. The petiolules are fine and so are the nerves and midrib. The venation is reticulate. The stipules are paired, small, fine, linear and brown. The hypocotyl, shoot and petioles are pubescent and to a lesser extent the undersides of the midribs and some nerves.

NATURAL REGENERATION. The paucity of natural regeneration of A. elata is a silvicultural problem. A sufficient quantity of seed is produced annually to expect a noticeable amount of regeneration from it. However, natural seedlings are remarkably rare. Aubréville (2) makes especial mention of this tree for the Ivory Coast..."We searched for a long time without finding a tree of this species small enough to enable a specimen to be cut easily, and we had to fell a big tree. The local people claimed that this species 'did not make small ones'" Whatever environmental conditions are lacking at present to promote the natural regeneration of this tree, they do not seem to be governed by light. In natural regeneration experiments in Afrormosia elata forest, it has been observed that the seedlings of this species are scarce, no matter whether the overhead canopy be light, medium or dense. It has been suggested that insect damage to the seeds may be a cause of the scarcity of regeneration. But it is not thought that this species is more liable to insect damage than others, especially as its germination period is short. Whatever the cause, it is a fact that this species is going through a period of sparse recruitment.

Growth is slow in early youth, but increases when more overhead light is available.

ARTIFICIAL REGENERATION. There are about 128 seeds to an ounce. Germination takes place in 8 days.

FIELD NOTES. There is sometimes confusion between Afrormosia elata and Distemonanthus benthamianus. The alleged similarity lies in the bole colouring of red. Some spot characters are as follows:

Character	Afrormosia	Distemonanthus
Bole	Light coloured, peeling off to leave rusty blotches.	Red, especially towards the top. Peels off on the lower part to leave light coloured marks.
Leaflets	Stipellae present.	Stipellae absent.
Flower	S5 P5 A10 G1	S5 P3 A3-2 G1
Pod	With marginal ridges	Not ridged.
Seed	Notched margin	Entire.

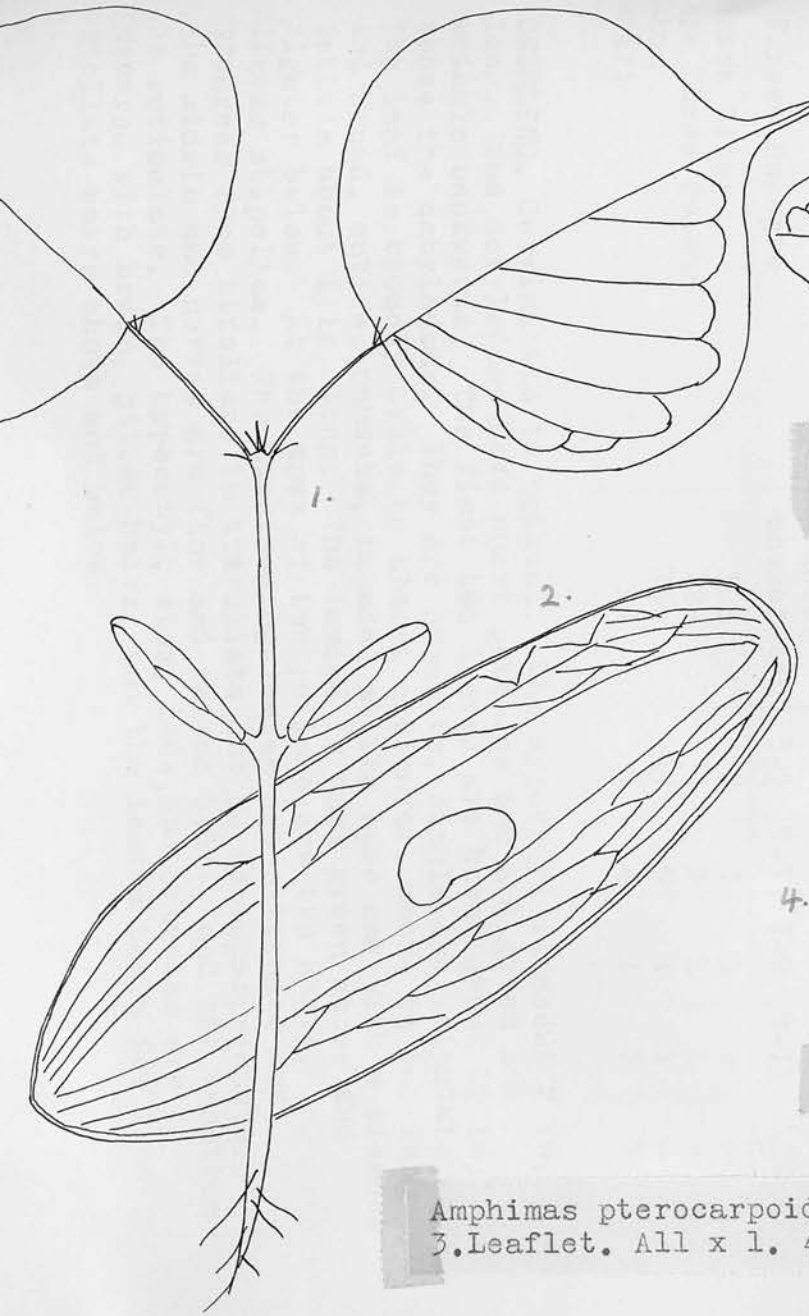
2. AMPHIMAS Pierre

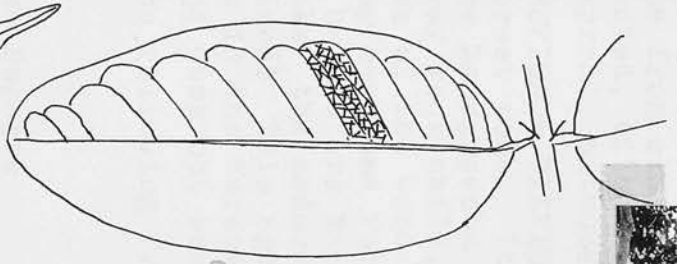
Amphimas pterocarpoides Harms

VERNACULAR NAMES. Asanfran (T). Eyelebra (Nz). Masegyewoba (T). Wonyan (S). Yaya (Ash,D,W).

A tree of about 130 ft. high and 10 ft. girth. The bole is long and slender and buttresses develop, reaching to a height of perhaps 10 ft. Often the rounded crown is fairly small and compact, but may be medium sized when old. The foliage is quite dense and dark. The bark is dark brown and shaggy when young and scaly when older. The thick slash is brown with black, vertical, narrow lines in the outer layer due to the vessels, and red in the inner layer from which a red, sticky juice exudes in droplets. The yellow sapwood appears somewhat fibrous and in it the transverse walls of the vessels are visible. The heart is yellow-ish brown, hard, heavy, strong and coarse, but not durable. In transverse section, the scattered vessels, the many fine medullary rays and the wavy, continuous bands of parenchyma are visible. (Sometimes the mature crown of dark leaves appears at first glance to resemble Khaya ivorensis or Entandrophragma angolense or E. cylindricum.)

BOTANY. The leaves are alternate, stipulate, imparipinnate, with 5 or more pairs of opposite or subopposite leaflets and a terminal one. The rhachis is about 6-9 in. long, red-brown and velvety. There is a narrow, persistent, pointed stipella, about 0.15 in. to each leaflet, on the upper side. The leaflet is oblong-lanceolate, about 3 in. long and 1 in. broad, entire, obtuse, rounded at the base, glabrous, dark green and shiny above, and with a short petiolule about 0.1 in. long. The midrib is raised below. The nerves are fine, regular and looped, and the venation is reticulate. The inflorescences are paniculate. The flower consists of 5 united green sepals, 5 greenish-yellow petals about 1 in. long and bifurcated deeply, 10 stamens nearly as long as the petals and with dark brown anthers, and a superior, unilocular ovary containing 2 ovules. The flat, papery pod may be up to 8 in. long and 2 in. broad, including the surrounding wing, and contains a single, reniform, red-brown seed, about $\frac{3}{4}$ in. long. The young





Amphimas pterocarpoides. 1.Seedling. 2.Fruit.
3.Leaflet. All x 1. 4.Bole. 5.Tree.

branchlet is stout, rusty tomentellous, and is rather characteristic with its grouped, red-brown, large stipules.

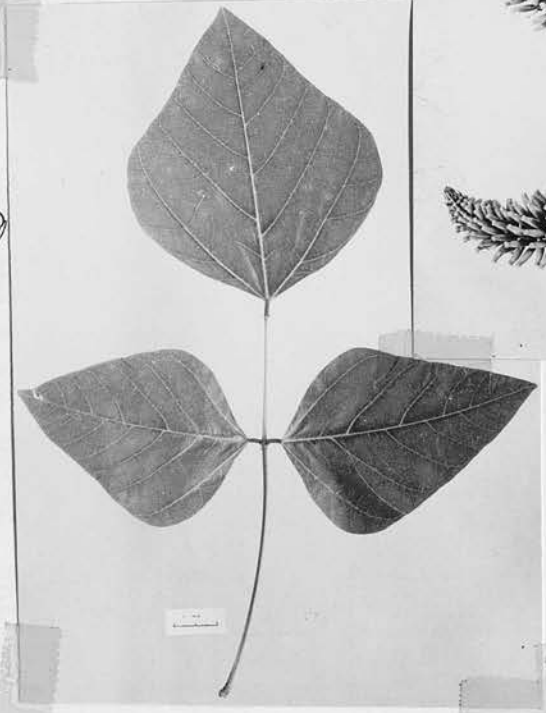
PHENOLOGY. The tree is deciduous in October-November. (A 10 ft. high sapling has been seen leafless but with stipules.) Leaf shedding begins with the appearance of the flowers. The crown then becomes a mass of light golden brown flowers which do not last long. The new leaves begin to appear towards the end of November, but some trees may remain leafless till March. The large, pendulous pods are quite plentiful and are conspicuous on the trees; they are ripe from mid February to April. They are light and are wind distributed, either complete, or after splitting into halves. Their spread, although not distant, is quite good.

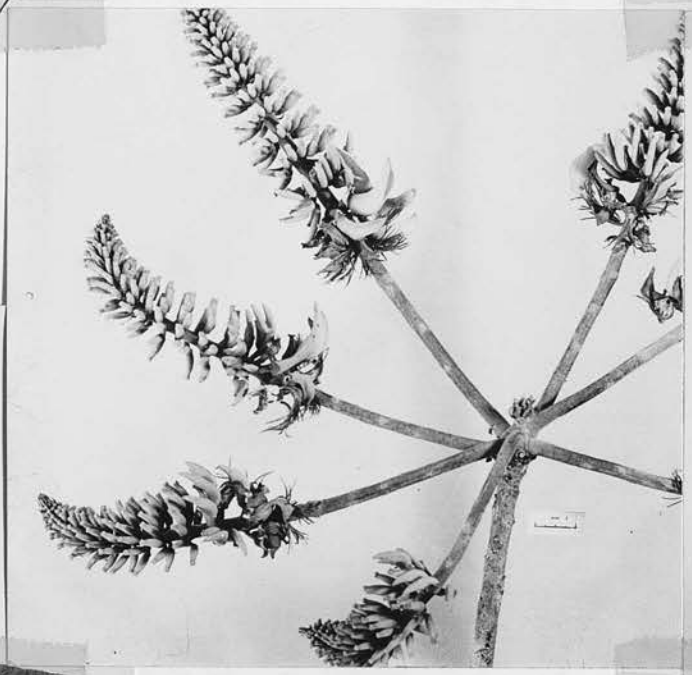
DISTRIBUTION & SILVICULTURE. Amphimas is scattered throughout the High Forest zone. It is common in farm land and in old clearings. The name Masegyewoba means in Twi "Father-in-law (or mother-in-law), take away your child." This is said to owe its derivation to the hardness of the wood and the difficulty of felling the trees in clearing new land for farms. When a son-in-law finds too many such trees, he prefers to return his wife to her parents rather than undertake the arduous task of felling the trees on his father-in-law's land! This species is a light demander, and is to be found in gaps in the forest. Although reaching the upper storey, Amphimas does not become a dominant in closed forest.

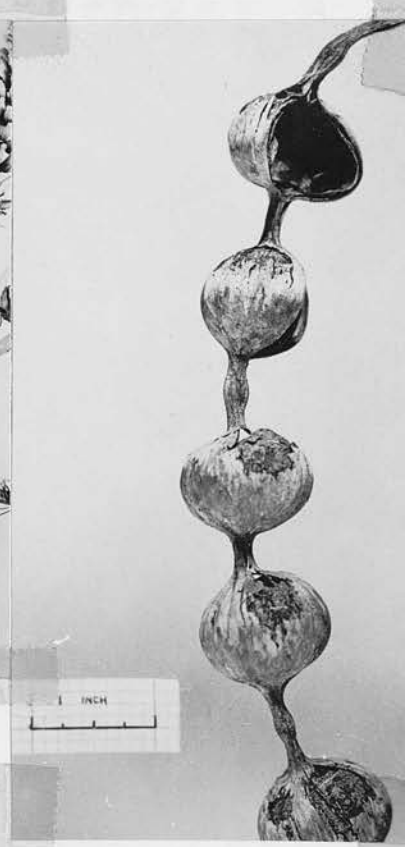
The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Ankasa River	120	3	3	1	-	-
Cape Three Points	129	4	3	1	1	-
Kakum	150	15	5	4	1	-
Bobiri	94	6	4	1	2	2

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long. The cotyledons have short petioles and are green and wrinkle backwards. The first two leaves are borne about 1½ in. above the cotyledons. They are opposite, simple and stipulate. The leaf is broadly ovate to almost orbicular, about 2½ in. long and broad, entire, caudate, rounded at the base and with a slender petiole about 1 in. long. The lamina is dark green above and lighter below. At the apex of the petiole are two short, linear stipellae. The succeesding leaves are alternate and progress from bifoliate to trifoliate and so to imparipinnate. The midrib and nerves are fine and raised below, and the venation is reticulate. The hypocotyl, stem, buds, and petioles are covered with brown, pilose hairs, and the lamina has a few fine stellate hairs above and below.







Erythrina addisoniae. 1.Bole. 2.Seedling x 1. 3,Leaf. 4.Flowers. 5.Pod.

NATURAL REGENERATION. Many young seedlings are to be seen from February to April, but unless light conditions are suitable, few get beyond the stage of the first two primary leaves. But growth is rapid where there are open conditions, such as in farm clearings.

ARTIFICIAL REGENERATION. There are about 40 seeds to an ounce. Germination is about 95% and the period is about 22 days. Growth is irregular, and at 18 months heights vary between 8 in. and 2 ft. 9 in.

3. ERYTHRINA L.

A genus of small trees with showy inflorescences, trifoliate leaves and armed with spines. In addition to those described below there is E. senegalensis DC., a small tree of the Savannah-Woodland.

SPECIES. (i). E. addisoniae Hutch.& Dalz. (ii) E. altissima A.Chev. (iii) E. bancoensis Aubr.& Pellegr.

(i) Erythrina addisoniae Hutch.& Dalz.

VERNACULAR NAMES. Oso (Ash). Osorowa (T). These are not specific and are applied to other members of this genus.

A small tree, often not exceeding about 40 ft. high and 6 ft. G.B.H., but occasionally trees of up to 100 ft. high are to be found. The bole is usually short and is without buttresses. It is armed with spines which tend to disappear on the older parts. Thick, corky, longitudinal ridges are then developed. The crown is rather open. The slash is thick, fairly hard, and is white through the ridges, then a yellow layer followed by a faintly brown one. There is a dirty red-brown, sticky exudate. The sapwood is white and the heart yellow. The tree is grown for ornamental purposes in Kumasi, but its deciduous period is too long for this use. The bark is used as a cure for dysentery in children.

BOTANY. The leaves are trifoliate, alternate and stipulate, and the branchlets are armed with numerous spines. The leaf is large, up to about 15 in. long and 11 in. broad. The lateral leaflets are deltoid, about 5 in. long and 4 in. broad, entire, acute, broadly cuneate, glabrous, and with a short, swollen petiolule about 0.3 in. long. The midrib and nerves are slightly raised below. The lowest pair of nerves originate from the base of the lamina. The venation is reticulate. The terminal leaflet is similar, but is larger and deltoid-ovate in shape. The rhachis and petiolules have a slight rufous pubescence when young.. On the underside of the rhachis are a few recurved spines. On the upper side there are two swollen appendages at the base of

the terminal leaflet petiolule, and another two where the lateral leaflets join the rhachis. These may be modified stipellae. The brilliant red flowers are in terminal whorled spikes about 14 in. long. The flower is pentamerous. The petals are red and the standard is the largest. Nine of the stamens are united and one is free. The fruit is a pendulous, light brown, dehiscent pod, up to about 14 in. and $\frac{3}{4}$ in. diameter, constricted between each seed chamber. There are usually 9-12 seeds to each pod. The seed is bright red with a black hilum.

PHENOLOGY. E. addisoniae may be deciduous from December to May, although some individuals are leafless for shorter periods. Flowering is most conspicuous and takes place from April to mid June. The trees are usually when flowering begins but are flushing new leaves before the flowers are over. The pods ripen from July to October. They open on the tree, exposing the red seeds, but these often remain in the pods for some time afterwards. The pods themselves persist for a year.

DISTRIBUTION. This species seems to be confined to the northern part of the High Forest Zone, i.e. the Celtis-Triplochiton and Antiaris-Chlorophora Associations. It is scattered as individuals.

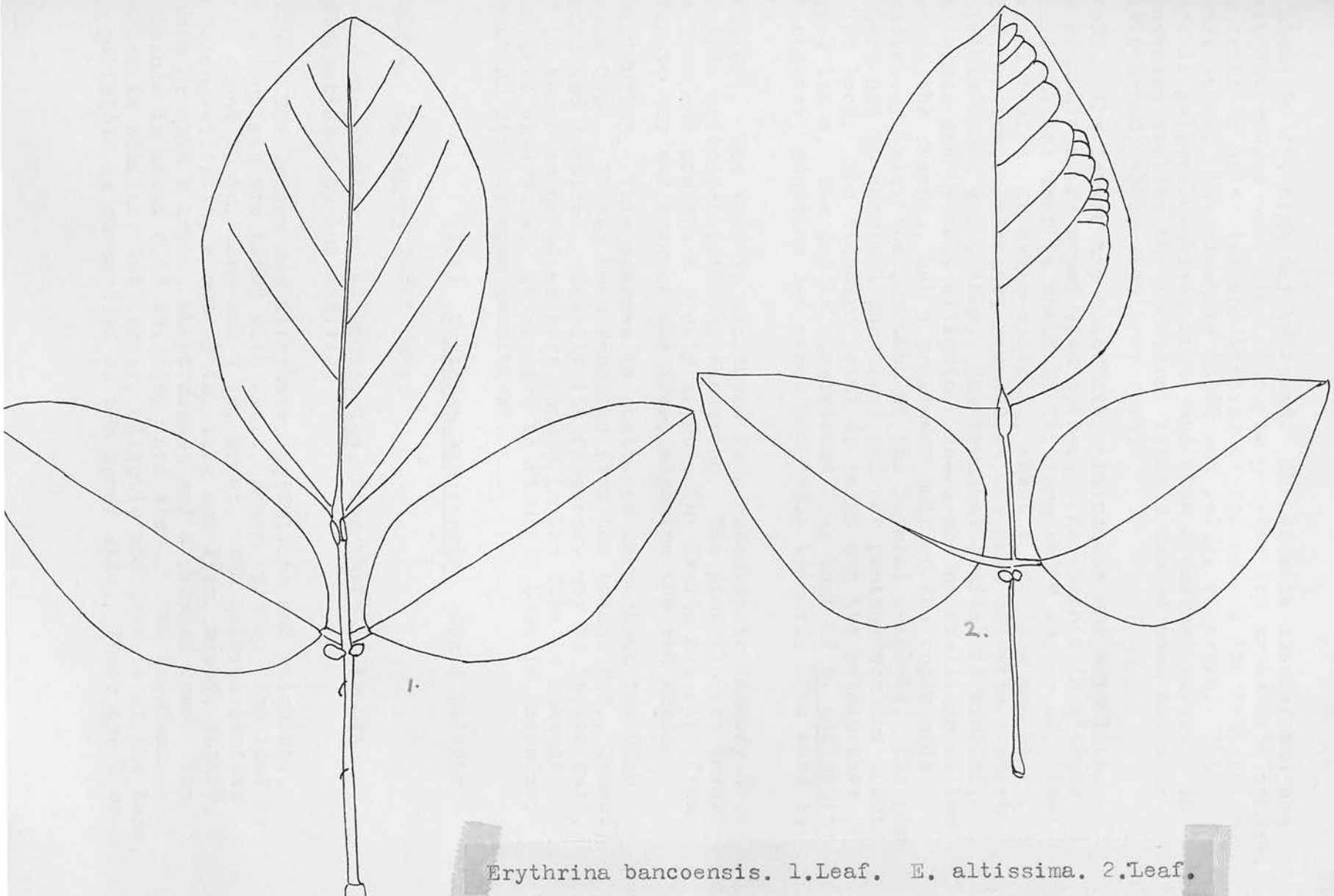
SEEDLING. Germination is epigeal. The hypocotyl is about $1\frac{1}{2}$ in. long, thick and light green. The cotyledons do not enlarge and are thick, light green, oblong, about $\frac{1}{2}$ in. long and $\frac{1}{4}$ in. broad, rounded at the apex, slightly auriculate at the base and sessile. The shoot is light green, considerably thinner than the hypocotyl, and armed with a few very small spines. The first two leaves are opposite and are borne about $1\frac{1}{2}$ in. above the cotyledons. The primary leaf is simple, ovate, about $1\frac{3}{4}$ in. long and $1\frac{1}{2}$ in. broad, entire, acuminate, sometimes slightly cordate or with an almost rounded base. The petiole is about 1 in. long and the stipules are small. At the apex of the petiole is a pair of small outgrowths, possibly modified stipellae. The leaf is 3- or 5-nerved from the base. The succeeding leaves are alternate. The 3rd. leaf is trifoliate, with the terminal leaflet much bigger than the lateral ones.

ARTIFICIAL REGENERATION. There are about 64 seeds to an ounce. Germination takes place in 7 days and is about 96%

(ii) Erythrina altissima A.Chev.

VERNACULAR NAMES. Nfunudua (W). Oso (Ash). Osorowa (F,T). Wosoronin (Ash).

A tree of about 60 ft. high and 5 ft. G.B.H. but some specimens



Erythrina bancoensis. 1.Leaf. E. altissima. 2.Leaf.

of about 90 ft. high may be found. The bole is slender and has short buttresses when old. The young stems are armed with spines. The crown is often low and tending to spread and the foliage is not dense. The slash is thick and yellow to brown. The heart is yellowish-white, light and with a coarse texture. In transverse section the scattered vessels can be seen and also fairly broad, white medullary rays.

BOTANY. The leaves are alternate, trifoliate and stipulate. The branchlets are armed with spines. The rhachis is without spines and the leaf is about 10 in. long and 9 in. broad. The lateral leaflet is ovate-elliptic, about 4 in. long and 2¼ in. broad, entire, acuminate, rounded at the base and with a short petiolule about ¼ in. long. The terminal leaflet is similar, but larger and broadly elliptic. There are no swellings at the apex of the rhachis, but a prominent pair on the upper side immediately below the junction of the lateral leaflets. The pink flowers are in terminal panicles, and are pentamerous and about 1¼ in. long. The standard petal is large and the petals have jagged lobes. The pod is constricted like that of E. addisoniae, but shorter, contains 3-6 seeds and tends to curl. The seed is red.

PHENOLOGY. The tree is deciduous from November to January and this coincides with the flowering. The pink flowers cover the tree and present a pretty sight. The fruits are ripe from March to May and open on the tree, exposing the red seeds.

DISTRIBUTION. This species is scattered throughout the High Forest Zone. It has been recorded from the Ankasa F.R., Kumasi, Swedru and Togoland. Usually its frequency may be termed rare, but is has been noted as more common in the Nuba to Sekondi area than elsewhere. It appears to flourish best in Secondary Forest or similar open conditions.

(iii) Erythina bancoensis Aubr.& Pellegr.

SYNONYM. E. vignei Burtt Davy.

A tree similar to E. addisoniae, from which it is not differentiated by the natives.

BOTANY. The leaves are alternate, trifoliate and stipulate. The branchlets are armed with short, sharp spines. The leaf is up to about 10 in. long and 7 in. broad. The lateral leaflet is oblong-elliptic, about 3½ in. long and 1¾ in. broad, entire, obtuse or with a broad, short acumen and a rounded base. The petiolule is about 0.15 in. long, and stout. The terminal leaflet is similar, but larger, elliptic and cuneate at the base. Its petiolule is channelled on the upper side. There are 1 or 2

small, black, recurved spines on the underside of the rhachis. On the upper side there is a pair of swellings immediately below the junction of the lateral leaflets; they are possibly modified stipellae. The petiolules and undersides of the leaflets are pubescent, and slightly so on the underside of the lamina. The midrib and nerves are raised below and there are two basal nerves. The venation is reticulate. The orange-red flowers are borne in terminal racemes. The standard is large and almost covers the other petals. The stamens protrude obliquely downwards - 9 are united and 1 is free. The fruits have not been collected.

PHENOLOGY. The tree is deciduous from July to January, but individuals are leafless for shorter periods. Flowering takes place between July and October, on leafless trees.

DISTRIBUTION. This species appears to be uncommon. It has been observed at Dunkwa (where it was first recorded in the Gold Coast by C. Vigne), Kumasi and Bosusu.

RHAMNACEAE.

A family of trees, shrubs and climbers, often armed with thorns. The leaves are simple, alternate, sub-opposite or opposite, and usually stipular. The flowers are hermaphrodite, consisting of 4-5 sepals, 4-5 or no petals, 4-5 stamens alternating with the sepals, and a superior ovary, but sometimes sub-inferior, consisting of 2-4 united carpels, with often only one ovule in each loculus. The fruit is often a drupe or nut.

The genus Zizyphus Adans. belongs to this family and it comprises small trees and straggling shrubs in the Savannah-Woodland.

MAESOPSIS Engl.

SYNONYMS. Karlea berchemoides Pierre M. berchemoides A.Chev.

VERNACULAR NAMES. Eyamdua (Ash). Gotrobo (E). Kwaese (W). Onwamdua (Ash).

A slender tree with a height of about 90 ft., a clear bole of about 70 ft. and 7-9 ft. G.B.H. The bole is straight, cylindrical and without buttresses. The crown is light and the leaves are arranged horizontally. In old trees there is a tendency for 2 or 3 branches to develop almost at right angles to the stem. The bark is light grey, with a slight indication of shallow, regular, vertical fissures. The outer slash is red with vertical white lines in it, and the inner slash is thick, fibrous and yellow, and smells of boiled chicken. The sapwood is white and lustrous. The heart is russet-brown, fairly soft, moderately light, 30 lb. per cu. ft. at 15% moisture content, somewhat lustrous and with a medium texture. It is not durable against fungi and termites. In transverse section, the small vessels and the fine, numerous medullary rays are just visible. With a hand lens the parenchyma ring around each vessel can be seen, and the medullary rays appear redder than the wood.

The name Eyamdua (guinea worm tree) is due to an infusion of the bark being used for guinea worm infections. A purgative is made from another infusion.

BOTANY. The leaves are simple, alternate, sub-opposite or opposite, and have paired stipules about 0.2 in. long. The leaf is broadly oblong-lanceolate, about 4 in. long and 1½ in. broad, serrate, acuminate, broadly cuneate or almost rounded at the base and with a short petiole about 0.1 in. long. The midrib and nerves are raised below. In old trees the serrations may be absent. The flowers are yellow-green and are in small axillary

Maesopsis eminii. 1.Fruit. 2.Seedling.
3. Leaves. All x 1.

cymes. There are 5 united sepals, 5 small hooded petals, 5 stamens opposite and almost covered by the petals, and a superior unilocular ovary. The fruit is an oblong drupe, about 1 in. long, blackish when ripe, and with a hard stone.

PHENOLOGY. The tree is deciduous from January to about mid April. Flowering begins with the flush of new leaves and lasts till July. The ripe fruits are available in November and December. They are eaten by birds, largely by plantain eaters and hornbills - thus the name Onwamdua (hornbill tree). Many of the fruits fall below the mother trees. However, dissemination must be considered good, for young plants are found a long way from mature trees.

DISTRIBUTION & SILVICULTURE. The true distribution of Maesopsis lies within the northern limit of the High Forest Zone, particularly in the Antiaris-Chlorophora Association. It appears to be more common in Togoland and in the area north of Begoro. However, individual trees are to be found here and there in other parts of the High Forest, but are rare. A record of this tree is as far south as the Subri F.R. These scattered trees are likely to be the result of seed carried by the larger birds. Maesopsis is a light demander throughout its life; it cannot tolerate shade.

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long and slender. The cotyledons do not develop, and are thick, about $\frac{1}{2}$ in. long and 0.3 in. broad, more or less rectangular, but tapering towards the base. At first they are green, but become black and shrivelled. The first two leaves are borne about $1\frac{1}{2}$ in. above the cotyledons and are opposite. The succeeding leaves are alternate. The primary leaf is simple, oblong-elliptic, about $1\frac{1}{2}$ long and $\frac{3}{4}$ in. broad, serrate, acuminate, broadly cuneate or almost rounded at the base, with a petiole about $\frac{1}{4}$ in. long and subtended by two very small, green, recurved stipules. There is a very slight and almost indistinct pubescence on the stem and petioles.

NATURAL REGENERATION. Much regeneration is usual under mother trees, but it dies early unless overhead light is available straightaway and is maintained. Occasional seedlings are to be found in gaps in the High Forest far from mother trees due to the transport of seed by the larger birds. Growth of the seedling and sapling is rapid, as long as an open overhead canopy is maintained.

ARTIFICIAL REGENERATION. There are about 20 fruits to an ounce. Germination is erratic and may last from 4-78 days. About 66% of the seeds germinate within 30 days. Growth is very rapid as will be seen from the following recordings from Togoland of different lots of sowings:

Age	Height	G.B.H.
6 months	2 ft.	-
7 "	4	-
1½ years	22	-
2 "	18	7 in.
2½ "	15	18
2½	20	15
2½	22	19½
2½	23	17½

Maesopsis is being used in taungya plantations in Togoland. 1 year old stumped plants have given 90% survival for June plantings, and 40% for June plantings. Height and girth details for some taungya plantations are as follows:

Age of Plantation	Height	G.B.H.	Spacing
10 years	50 ft.	2 ft. 3 in.	6ft. x 6 ft.
3	30	1 3	12 X 12
3	32	1 6½	12 X 12
1 year	16	- 8¼	16½ X 16½.

RHIZOPHORACEAE.

A family of trees and shrubs, especially known because of the mangroves of the genus Rhizophora L. The leaves are simple, usually opposite, sometimes verticillate, occasionally alternate, and normally stipulate. The flowers are hermaphrodite, with 4-8 sepals, 4-8 petals, 8-∞ stamens and a syncarpous ovary of 2-5 loculi, which may be superior or inferior. The flowers are axillary and often small.

GENERA. 1. Anopyxis Pierre 2. Rhizophora L.

1. ANOPYXIS Pierre

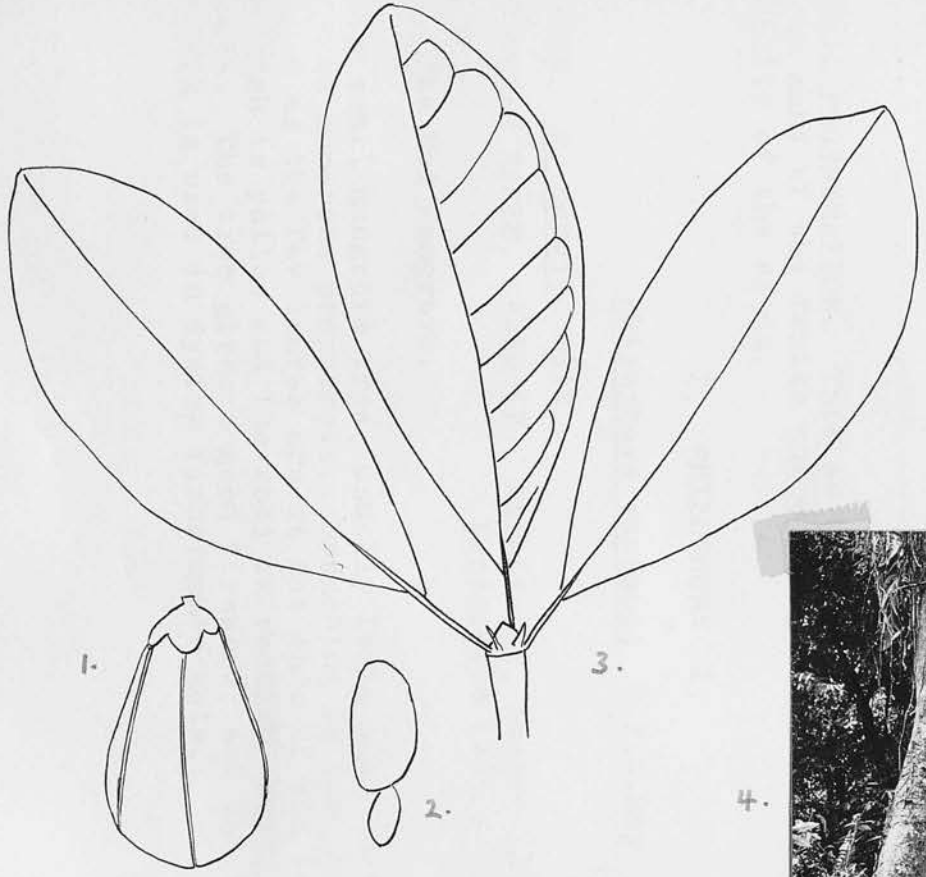
Anopyxis ealaensis Sprague

SYNONYMS. A. occidentalis A.Chev. Pynaertia ealaensis De Wild.

VERNACULAR NAMES. Abari (Ao,Nz). Abra (W). Ankyi (F). Kokoti (Ash,T,W) Kokoti is the name for bush pig - the slash of the tree is said to resemble the colour of the bush pig's flesh.

A tall tree with a characteristic, straight, cylindrical stem; only sometimes are short, low buttresses developed. A felled tree had a height of 163 ft., a bole 113 ft. long and a girth at 8 ft. high of 9 ft. 2 in. The crown is rounded, fairly compact, large but not spreading. The bark is light grey and smooth. The slash is thick, brittle, granular and brown. The sapwood is yellowish-brown. The heart is similar and is hard and heavy, about 61 lb. per cu. ft. seasoned, coarse and not durable. In transverse section, the numerous vessels and medullary rays are just visible but the short bands of parenchyma are very conspicuous. Gum is noticeable in the vessels in longitudinal section. The tree is said to provide a good fuel wood (43).

BOTANY. The leaves are simple and in whorls of threes. The stipules are short, triangular and deciduous. The leaf is broadly oblong-oblanceolate to elliptic, about 3 in. long and 1½ in. broad, entire, obtuse or rounded at the apex, cuneate at the base, coriaceous, glabrous, shiny above, and with a petiole about 0.4 in. long. The midrib is raised below. The nerves are fine and the venation is reticulate and hardly visible. The flowers are in short axillary cymes. The flower consists of 5 greenish-yellow united sepals, softly tomentellous and lobed, 5 free petals, brown and linear, 10 exserted anthers on a staminal tube similar to that found in the Meliaceae, and a superior 5-locular ovary. The fruit is an ellipsoid, dry capsule, about 1½ in. long, broadest at the apex, grey-green and velvety



Anopyxis ealaensis. 1.Fruit.
2.Seed. 3.Leaves. All x 1.
4.Bole. Rhizophora racemosa.
5. Flowering branchlet.

on the outside, with the persistent calyx at the base. The fruit is more or less woody, 5 valved and dehiscent, containing many seeds. The seed is brown, about ¼ in. long and with a terminal wing about ¾ in. long.

PHENOLOGY. The principal flowering season is from July to September, and the fruits are ripe from December to March. The fruits are capable of dehiscing on the tree, but it is remarkable how many do fall to the ground unopened. Flowering is profuse and fruiting is plentiful.

DISTRIBUTION. Anopyxis is found over most of the High Forest. It is never common but is more frequent in the Rain Forest and the Lophira-Triplochiton Association than elsewhere. In other parts it is scattered and becomes rare along the northern limits of the High Forest Zone.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Ankasa River	120	2	2	4	6	1
Subri	965	22	31	55	74	21
Fure	381	7	35	36	17	4
Bobiri	94	1	2	-	-	1

NATURAL REGENERATION. This is uncommon and seems to be mainly due to many of the fruits not opening and to the very poor viability of the seeds.

2. RHIZOPHORA L.

Rhizophora racemosa G.F.W.Mey

SYNONYM. R. mangle Oliv.

VERNACULAR NAMES. Abin (F). Atrati (E). Asopro (F). Godo (Ga). Kweigyabra (F).

The Red Mangrove.

A small mangrove tree, usually leass than 20 ft. high and with numerous prop roots. Branching is low, but the crown is open as the few leaves are at the ends of the branchlets. The slash is yellow and the wood is reddish, hard, heavy and durable. The tree gives a good firewood, and the tannin from the bark is used in dyeing fishermen's nets.

BOTANY. The leaves are simple, opposite and with caducous, interpetiolar stipules. The leaf is oblanceolate, about 3 in. long and 1 in. broad, entire, obtuse at the apex, broadly cuneate at the base, coriaceous, and with a petiole about ½ in. long. The nervation is almost indistinct. The flowers are in axillary cymes. The flower consists of 4 small sepals which are only teeth, 4 yellow-green, thick petals almost ½ in. long, 8 short stamens set in square formation and an inferior ovary of 2 loculi and surmounted by a bifurcated style.

PHENOLOGY. Flowers are produced in March and April, but are not plentiful. The ripe fruits are available in October-December. Germination is viviparous, and according to Aubréville (1) the radicle is about 12 in. long before the seedling drops off the tree.

DISTRIBUTION & SILVICULTURE. This species is the least common of the Gold Coast mangroves. It has been recorded from Half Assini, Esiama, near Princes Town, Elmina and Keta, and grows gregariously in saline water on the seaward side in mangrove swamps.

ROSACEAE.

This large family contains very few big trees. The leaves are usually alternate, simple or compound, with stipules which are often adnate to the petiole, and sometimes with one or two glands on the leaflet. The perianth is pentamerous, and the ovary may be apocarpous or syncarpous, superior or inferior. The fruit is various.

PARINARI Aubl.

Besides the species described below, there are P. curatellaefolia Planch. and P. polyandra Benth., small trees found in the Savannah-Woodland.

SPECIES. (i) P. excelsa Sabine (ii) P. glabra Oliv.
(iii) P. robusta Oliv. (iv) P. subcordata Oliv.
(v) P. tenuifolia A.Chev.

(i) Parinari excelsa Sabine

SYNONYM. P. elliottii Engl.

A tree of about 120 ft. high, and similar to P. tenuifolia. The bole is slender and buttressed and the crown is rounded.

BOTANY. The leaves are alternate, simple and with caducous stipules. The leaf is ovate-elliptic, about 3½ in. long and 1½ in. broad, or larger, entire, broadly acuminate, cuneate to almost rounded at the base, and tomentose below. The midrib and nerves are raised below; the nerves are prominent and are more or less parallel to one another. The petiole is slender, about ½ in. long, and midway on its upper side are two small glands. The branchlets are covered with long silky hairs. The flowers are small and are in terminal panicles. The fruit is ellipsoid and similar to that of P. tenuifolia.

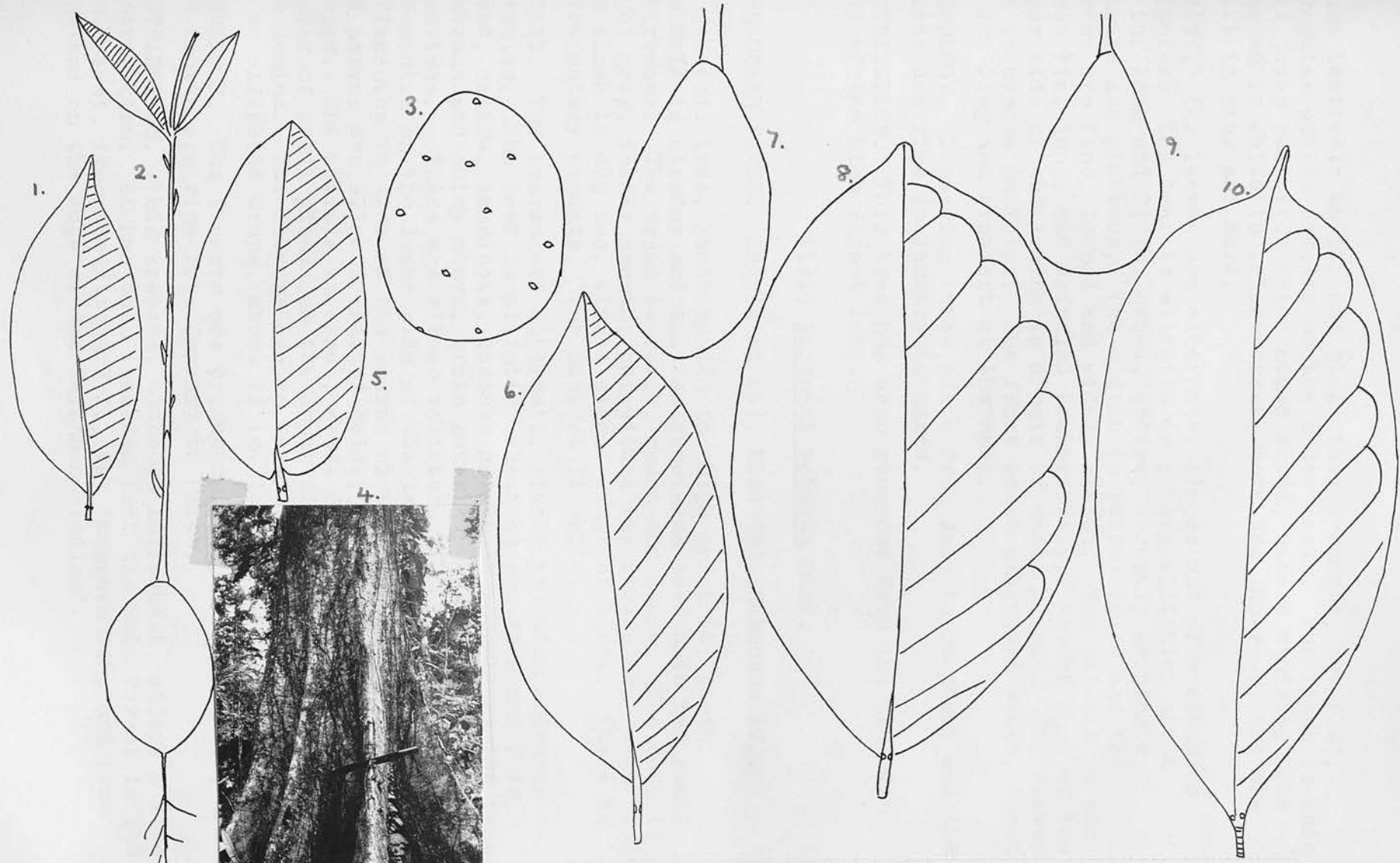
PHENOLOGY. Flowering takes place from February to April, and the fruits are ripe from November to March.

DISTRIBUTION. So far, the only records of this tree are from the Rain Forest.

(ii) Parinari glabra Oliv.

VERNACULAR NAMES. Kagyibiri (W). Punini (Nz).

A tall tree, reaching 110 ft. high and 9 ft. girth above buttresses. The bole is straight and cylindrical. The crown is spreading and may be fairly dense. The grey bark has white,



Parinari tenuifolia. 1.Leaf. 2.Seedling. 3.Fruit. 4.Bole. P.subcordata. 5.Leaf. P.excelsa. 6.Leaf. P.robusta. 7.Fruit. 8.Leaf. P.glabra. 9.Fruit. 10.Leaf. All x 1. except 4.

round lenticels on it, and it is fairly smooth, but flat, irregular scales develop on the older parts. The slash is thin, dull, deep red, from which comes a red, watery exudate. The sapwood is white to yellow-brown, hard and lustrous, and the heart is pink and hard.

BOTANY. The leaves are alternate, simple and with caducous stipules. The leaf is elliptic to oblong-elliptic, about 4½ in. long and 2¼ in. broad, entire, abruptly acuminate, cuneate and glabrous. The midrib is raised below and the nerves are fine, looped and widely spaced. The petiole is short, about ¼in. long, and wrinkled transversely. At the base of the upper side of the lamina is a pair of small glands. The flowers are in cymose panicles. The fruit is an ellipsoid drupe, about 1½ in. long and broadest at the apex.

PHENOLOGY. Flowering takes place from July to October, and the fruits are ripe in January to March.

DISTRIBUTION. This tree has been recorded from the southern half of the High Forest Zone.

(iii) Parinari robusta Oliv.

VERNACULAR NAMES. Kagyibiri (W). Klae (E). Kukuodua (T).

A tall tree, reaching 120 ft. high and 8 ft. girth. The bole is slender and the few specimens seen have had small buttresses. The vrown is large, round and dense. The bark is light grey, fairly smooth, but with a few irregular, large scales. The slash is ddp red, with a slight tinge of black. There is a red watery exudate. The sapwood is white.

BOTANY. The leaves are alternate, simple and with caducous stipules. The leaf is elliptic, about 4½ in. long and 2 in. broad, entire, acuminate, cuneate or almost rounded at the base, glabrous and shiny above, brown puberlous below but glabrous sometimes. There are either varietal differences in the indumentum on the lower side of the lamina, or else it may be diffenences in ages of the leaves or the trees. The midrib and nerves are slightly raised below; the nerves are fine and looped. The petiole is stout, about 0.3 in. long, and there is a pair of small glands on the upper side at its junction with the lamina. The flowers are in terminal panicles. The fruit is an ellipsoid drupe, about 2¼ in. long and smooth.

PHENOLOGY. The flowers are produced in September-October, and the fruits are ripe from January to March.

DISTRIBUTION. This species, although infrequent, enjoys a wide distribution. It has been recorded from the Rain Forest in the south-west, from the Aiyola F.R., the Pawnpawn F.R. and from Togoland on the edge of the Savannah-Woodland.

(iv) Parinari subcordata Oliv.

This tree exists in the Riverain Forest of the southern Savannah-Woodland, and even extends further north, but is always associated with rivers. It grows to about 50 ft. high and 5 ft. girth, and has a spreading crown. The leaf lies between that of P. excelsa and P. tenuifolia, and is ovate to elliptic, about 2 in. long and 1¼ in. broad, entire, obtuse at the apex, more or less cordate at the base, tomentose below but becoming glabrous in time. The midrib and nerves are conspicuous below. The nerves are close together and almost parallel with each other. The petiole is about 0.2 in. long and has 2 glands midway along its upper side.

(v) Parinari tenuifolia A.Chev.

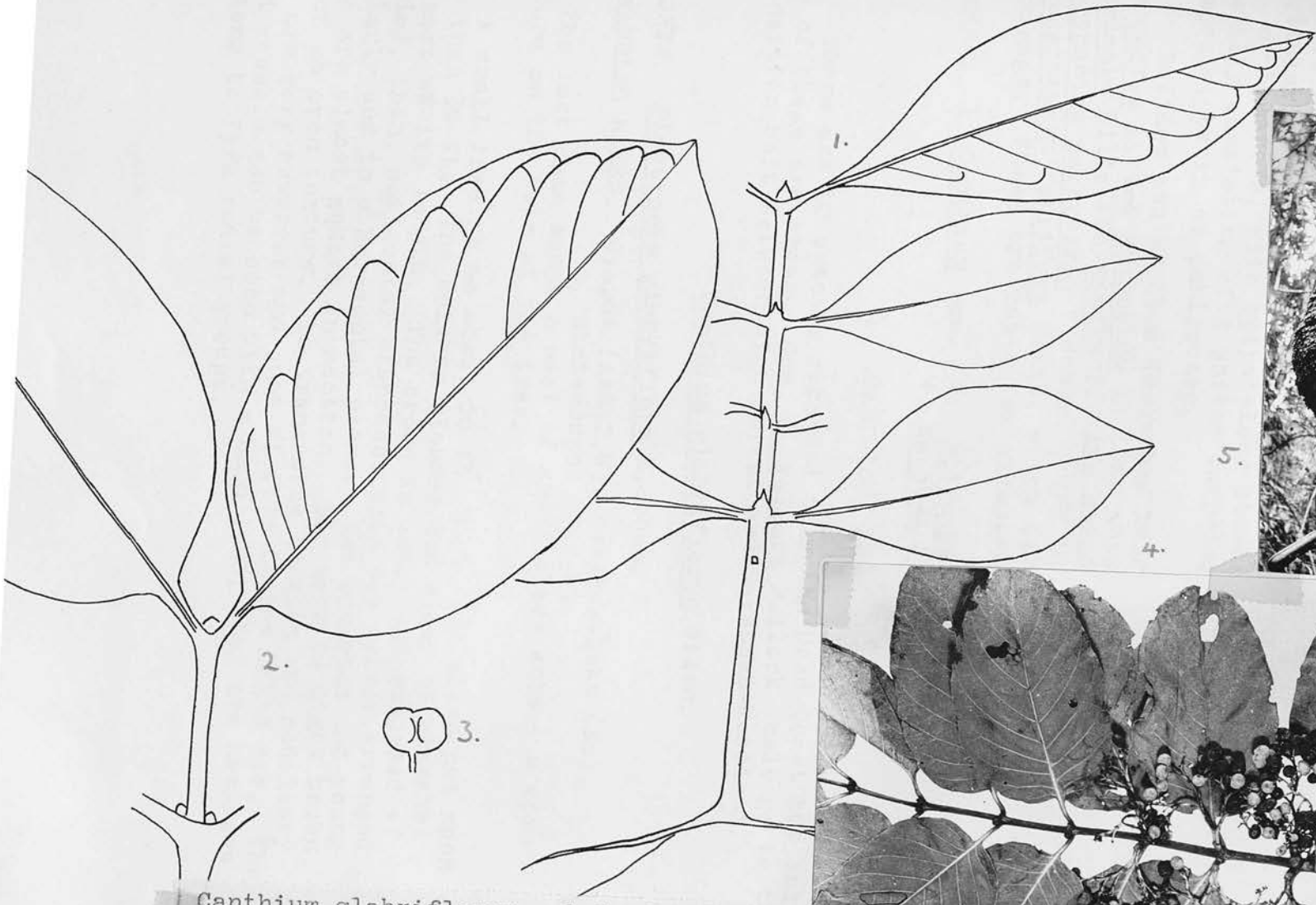
VERNACULAR NAMES. Afamfufuo (T,W). Faanle (Nz). Kotosima (Nz,S,W). Kwanedua (Ash).

A tall tree, 130 ft. or more in height and about 10 ft. girth above buttresses. The bole is slender and straight, with a tendency to fluting. The buttresses are close, narrow and high, sometimes extending to 15 ft. above ground. The crown is big, rounded, not dense, but with large branches. The grey bark is almost smooth, but may be slightly rough at times. The slash is liver coloured, granular and hard. The sapwood is yellow-brown. The heart is brown and hard. In transverse section, the scattered vessels are visible and so are the continuous, slightly wavy, fine parenchyma bands.

BOTANY. The leaves are alternate, simple and with caducous stipules. The leaf is oblong-lanceolate, about 2½ in. long and 1 in. broad, entire, acuminate, broadly cuneate, dark green above and with a golden brown woolly indumentum below. The midrib and the close and almost parallel nerves are prominent below. The petiole is about 0.2 in. long and has a pair of glands midway along its upper side. The caducous stipules are about 0.4 in. long. The branchlets are covered with short hairs. The flowers are in lax panicles. The fruit is a purplish drupe, like a small potato, nearly 2 in. long and 1½ in. broad, pitted on the outside and with silvery marks. The mesocarp is soft but the endocarp is hard. Lining the loculi are brown silky hairs. There are usually 2 oily seeds.

PHENOLOGY. Flowering takes place from February to April and the fruits are ripe from November to March. They fall to the ground and the pulp is eaten by small animals.

DISTRIBUTION & SILVICULTURE. Although more common in the Rain Forest, individuals of this species extend into the Celtis-Triplochiton Association of the Moist Semi-Deciduous Forest.



Canthium glabriflorum. 1.Seedling.
2.Leaves. 3.Fruit. All x 1.
4.Fruiting brahchlet. 5. Ants'
nest on bole.

RUBIACEAE.

This large family contains few big trees but is rich in shrubs. The leaves are simple, opposite and almost invariably entire. The stipules are often conspicuous and mostly interpetiolar, but may be intrapetiolar. The flowers are hermaphrodite, 4- or 5-merous, with epipetalous stamens, and an inferior ovary usually consisting of 2 united carpels. The fruit may be a capsule, berry or schizocarp.

Besides the species described below there are the shrubs of Coffea L. and Mussaenda L., the shrubs and small trees of Gardenia Ellis and Randia L., the common understorey tree Corynanthe pachyceras K.Schum. , and the Savannah-Woodland tree Crossopteryx febrifuga Benth. which is an indicator of impeded drainage. These are but a few examples from this large family.

GENERA. 1. Canthium Lam. 2. Mitragyna Korth. 3. Morinda Vaill. 4. Nauclea L.

1. CANTHIUM Lam.

There are 10 species recorded from the Gold Coast but only two of these are trees. One, C. vulgare Bullock belongs to the transition belt between High Forest and Savannah-Woodland.

Canthium glabriflorum Hiern.

SYNONYM. Plectronia glabriflora K.Schum.

VERNACULAR NAMES. Gyapam (Ash,T,W). Gyegyerabaka (Nz). Nteteadupow (S,T,W).

The last name means a nest of small black ants - a common feature on the bole of the tree.

A small tree up to about 50 ft. high, but often not much more than 30 ft. The bole is slender and clear of branches for most of its length. The crown is small and composed of whorled, thin, horizontal branches, with the leaves arranged regularly and in a horizontal plane. The branches and young stems are almost square in section. The wood is light brown and of an even texture. In transverse section the medullary rays are very numerous and just visible to the naked eye. The small vessels can be seen with a hand lens; they are numerous and tend to form radial groups.

BOTANY. The leaves are simple and opposite, with caducous, interpetiolar stipules. The leaf is ovate-elliptic, about 5 in. long and 3 in. broad, entire, with a short acumen, rounded at the base and glabrous after a while. The petiole is nearly ¾ in. long. The yellow midrib and nerves are prominent below. The conspicuous, small, white flowers are in axillary cymes. The calux is reduced to 5 teeth. There are 5 petals, 5 epipetalous stamens, and an inferior, 2-locular ovary, surmounted by an exserted style. The fruit is a black drupe about 0.6 in. diameter.

PHENOLOGY. The principal flowering season is from April to July, but individuals may be seen in flower from January onwards. The white flowers are profuse and appear from almost every leaf axil in short cymes on the upper side of the branch. The fruits are ripe in October-November and are produced in large numbers. They are eaten by birds and are well distributed.

DISTRIBUTION & SILVICULTURE. This species is scattered throughout the High Forest. It is a light demander and is a Secondary species, being rarely found in closed High Forest. It is common in clearings such as roadsides, railway track sides and in abandoned farms. It is not selective of site, as long as it is open, and is found on dry hillsides in Togoland, in the devastated mining areas near Tarkwa and in the seasonal swamps so common in the vicinity of Benso. Even when isolated, it cleans itself of its lower branches, which leave prominent scars on the trunk.

SEEDLING. Germination is epigeal. The hypocotyl is about 1½ in. long, woody and green. The leaves are simple, opposite and decussate. The first pair is close above the cotyledons. The leaf of the 4th. pair is oblong-elliptic, about 3 in. long and 1¼ in. broad, entire, acuminate, attenuated cuneate, with a sparse covering of bristles, particularly on the upper side of the lamina and along the margin. The midrib and nerves are raised below. The petiole is about 0.4 in. long. The stipules are interpetiolar, triangular and acuminate, about 0.15 in. long. The stem is green, woody and glabrous.

2. MITRAGYNA Korth.

Besides the two species described below, there is M. inermis O.Kuntze, a small tree, but sometimes resembling a shrub, of the Savannah-Woodland. There, typical of the genus, it is associated with water, either in swamps or in Riverain Woodland.

SPECIES. (i) M. ciliata Aubr.& Pellegr. (ii) M. stipulosa O.Kuntze

(i) Mitragyna ciliata Aubr.& Pellegr.

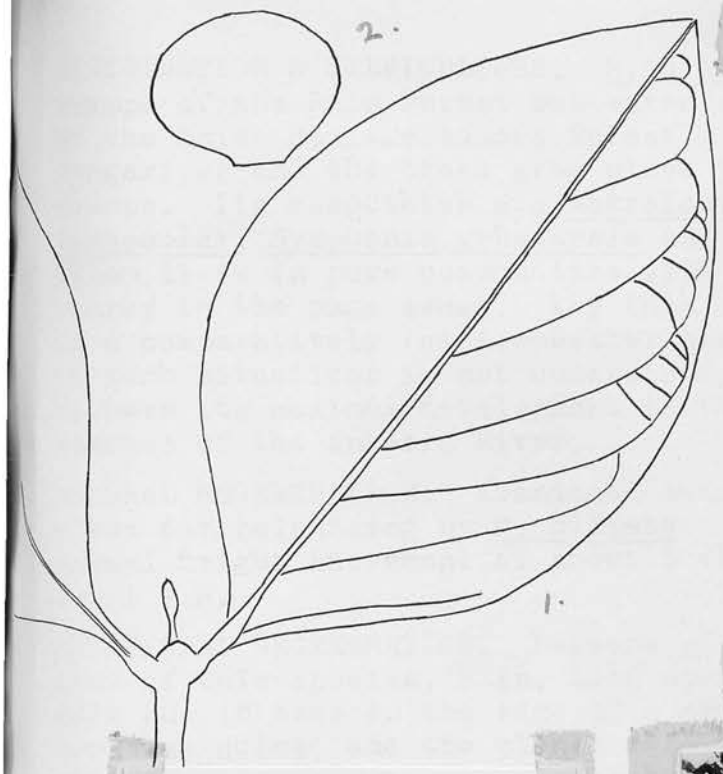
VERNACULAR NAMES. Beya (Nz). Subaha (Ash,F,T). The latter name is descriptive of the habitat - 'numerous in water'.

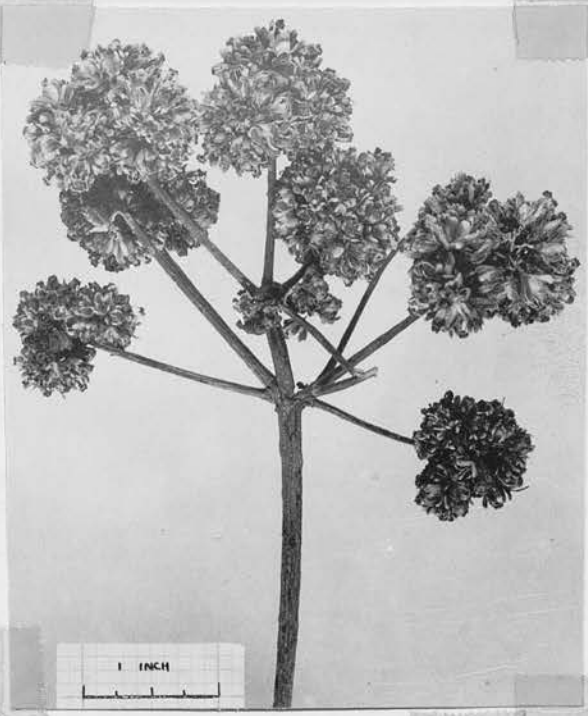
TRADE NAME. Abura.

A slender tree reaching about 80 ft. high and 9 ft. G.B.H. but some individuals may be bigger. A felled specimen had a toatl length of 151 ft. 8 in., a bole length of 86 ft. 8 in. and 11 ft. 3 in. G.B.H. The bole is straight, clear, cylindrical and not buttressed. The crown is small, close to the stem, but conspicuous because of its large leaves. The bark is grey-brown, with flat, thin scales. The slash is thick, almost fibrous, saffron with a pinkish under layer and very slightly scented. The sapwood is white. The heart is pinkish-yellow, moderately hard, about 35 lb. per cu. ft. at 12% moisture content, straight grained and of fine, uniform texture, but not resistant to decay. With a hand lens the many small vessels and numerous fine medullary rays can be seen. The wood has been used for brush backs and some classes of pattern making. Because of its peculiar property of being acid resistant, it is used for battery and accumulator boxes and for laboratory fittings.

BOTANY. The leaves are simple, opposite and with interpetiolar stipules. The leaf is obovate-elliptic, up to about 20 in. long and 12 in. broad in young plants, entire, rounded at the apex and almost rounded at the base, dull green above and very slightly pilose on the underside on the nerves. The midrib and nerves are prominently raised below. The veins are more or less parallel with themselves and at right angles to tne nerves. The stipule is foliaceous, red at first, and then green, almost spatulate in shape and about 1 in. long and 1½ in. broad. The infructescences are terminal capitate cymes, with up to about 10 heads in an inflorescence, and each 1 in. or thereabouts in diameter. The peduncles are about 1½ in. long and the common peduncle 3in. The flower is small and scented and consists of 5 sepals, 5 petals, 5 epipetalous stamens, and a 2-locular, inferior ovary, surmounted by a style which is exserted. The densely ciliate calyx is a specific character. The fruit is spherical and contains many seeds.

PHENOLOGY. The tree is evergreen. The new leaves and stipules flush red to bronze. Flowers have been collected in February and March, and ripe fruits in June and July. The many small seeds are dispersed by the action of the wind; the peduncles are hard and springy and the seeds are jerked out.





Morinda lucida. 1.Leaf. 2.Stipule. Both x 1.
Mitragyna ciliata. 3.Inflorescence. 4.Young trees.
M. stipulosa. 5. Trees.

DISTRIBUTION & SILVICULTURE. M. ciliata belongs to freshwater swamps of the Rain Forest but extends into the wouthern part of the Moist Semi-Deciduous Forest. It is a light demander, gregarious and the trees grow close together. It does not drain swamps. Its associates are Macrolobium splendidum, Randia lanepoolei, Symphonia gabonensis and Raphia vinifera. Quite often it is in pure communities with these associates growing nearby in the same swamp. Why this species should be restricted to a comparatively few freshwater swamps and not more universal in such situations is not understood. In the Gold Coast it appears to have its maximum development in the vicinity of the lower reaches of the Ankobra River.

NATURAL REGENERATION. Abandoned swamp-rice farms are a favourite place for colonising by M. ciliata. Growth is rapid and an annual height increment of about 2 ft. is not uncommon in the Subri F.R.

ARTIFICIAL REGENERATION. Because of the difficulty of collecting seed of this species, 5 in. long stem cuttings about $\frac{3}{4}$ in. diameter were put in beds on the edge of a swamp. Root and shoot development was quick, and the plants were used for stocking a small swamp. The first attempt to do the planting in the middle of the dry season was a failure. The next planting took place soon after the rains had begun (April) and complete establishment was obtained. Three years afterwards, many of the young plants were about 10 ft. high. There is a record of a height of 40 ft. beingachieved in 9 years in the Sui River taungyas.

FIELD NOTES. In the young state, there is sometimes confusion between Mitragyna and Nauclea. The main differences may be tabulated thus:

Character	Mitragyna	Nauclea
Habitat	Freshwater swamps	Only N. pobeguinii in swamps.
Flush of leaves	Red-bronze.	Green.
Lamina	Dull above.	Shiny above.
Fruit	Dry	Fleshy.

(ii) Mitragyna stipulosa O.Kuntze

SYNONYMS. M. chevalieri Krause M. macrophylla Hiern Nauclea macrophylla DC. N. stipulosa DC. N. stipulosa G.Don

This species is difficult to differentiate from M. ciliata except that it has a glabrous calyx (but the small flowers are not easy to collect for this character to be seen). In general it has a more northern distribution in the High Forest, and it does not grow to be such a big tree. The vegetative characters of the two species are alike.

It is worth recording that M. stipulosa has been found in Togoland at Vane, altitude nearly 2,000 ft., and not near water. However, this is unusual and may have been caused by man.

3. MORINDA Vaill.

There are two climbers and one tree.

Morinda lucida Benth.

SYNONYM. M. citrifolia A.Chev.

VERNACULAR NAMES. Ake (E). Amake (E). Atiati (E). Konkroma (Ash,F,T,W Sima (Nz).

A small tree, usually about 40 ft. high and 4 ft. G.B.H., but capable og growing to a medium sized tree. The bole is often short and not buttressed. The crown is deep but fairly compact. The bark is grey and scaly. The heartwood is yellow but darkens to brown on exposure. It is moderately hard, weighs 38 lb. per cu. ft. at 12% moisture content, has a somewhat coarse texture and a tendency to a spiral grain. In transverse section the vessels are just visible and the continuous, transverse, slightly wayy bands of parenchyma are prominent. The numerous, fine medullary rays can be seen with a hand lens.

BOTANY. The leaves are simple, opposite, and with early caducous interpetiolar stipules. The leaf is ovate-elliptic to broadly elliptic, about 4 in. long and 2½ in. broad, or bigger, entire, with a short, broad acumen, broadly cuneate and glabrous. The lamina is dark green and shiny above, lighter green and dull below. The petiole is about 0.3 in. long. The stipules are foliaceous, about ¾ in, long, 1 in. broad and almost orbicular. The small inflorescences are capitate. The flower is scented and consists of a reduced calyx, a white corolla tube of 5 petals about 0.6 in. long, 5 epipetalous stamens, and an inferior 4-locular ovary, surmounted by a slender style with 2 stigmata. The fruits are globose, fleshy, grouped, and about ¾ in. diameter.

PHENOLOGY. The main flowering season is March to May, and the ripe fruits are available in July-August. There are exceptions to these periods and flowers have been collected in January and fruits in February.

DISTRIBUTION & SILVICULTURE. M. lucida is found throughout the High Forest, but particularly in the transition belt to Savannah-Woodland, in Riverain Forest and also in the Coastal Scrub and Grassland. It is not common in the closed High Forest, but is found in and around the towns in the forest zone. Morinda is a light demander and its true environment is on the edge of the forest where open conditions exist. It thrives under quite dry conditions, as, for example, on the coastal plain.

ARTIFICIAL REGENERATION. Germination takes place in 14 days. In a trial plot in Kumasi, stumped plants were a success. Growth of the plants was erratic, and although many had attained a height of 3 ft. 6 in. in a year, the heights varied from 14-56 ft. and the girths B.H. from 7½ in. to 2 ft. 5 in. in 14 years. The planting distance was 6 ft. X 6 ft. However, this tree is unlikely to have any use in plantations.

4. NAUCLEA L.

This is the genus long known as Sarcocephalus Afz.

Besides the two tree species there is a straggling shrub which may develop into a small tree - N. latifolia Smith (syn. Sarcocephalus esculentus Afz.). This occurs throughout the Savannah-Woodland, in the Coastal Scrub and Grassland, and in places along the coastal strip where the Rain Forest meets the sea.

SPECIES. (i) N. diderrichii (De Wild.) Merrill
(ii) N. pobeguinii (Hua ex Pobéguin) Merrill

(i) Nauclea diderrichii (De Wild.) Merrill

SYNONYMS. Sarcocephalus diderrichii De Wild. S. trillesii Pierre

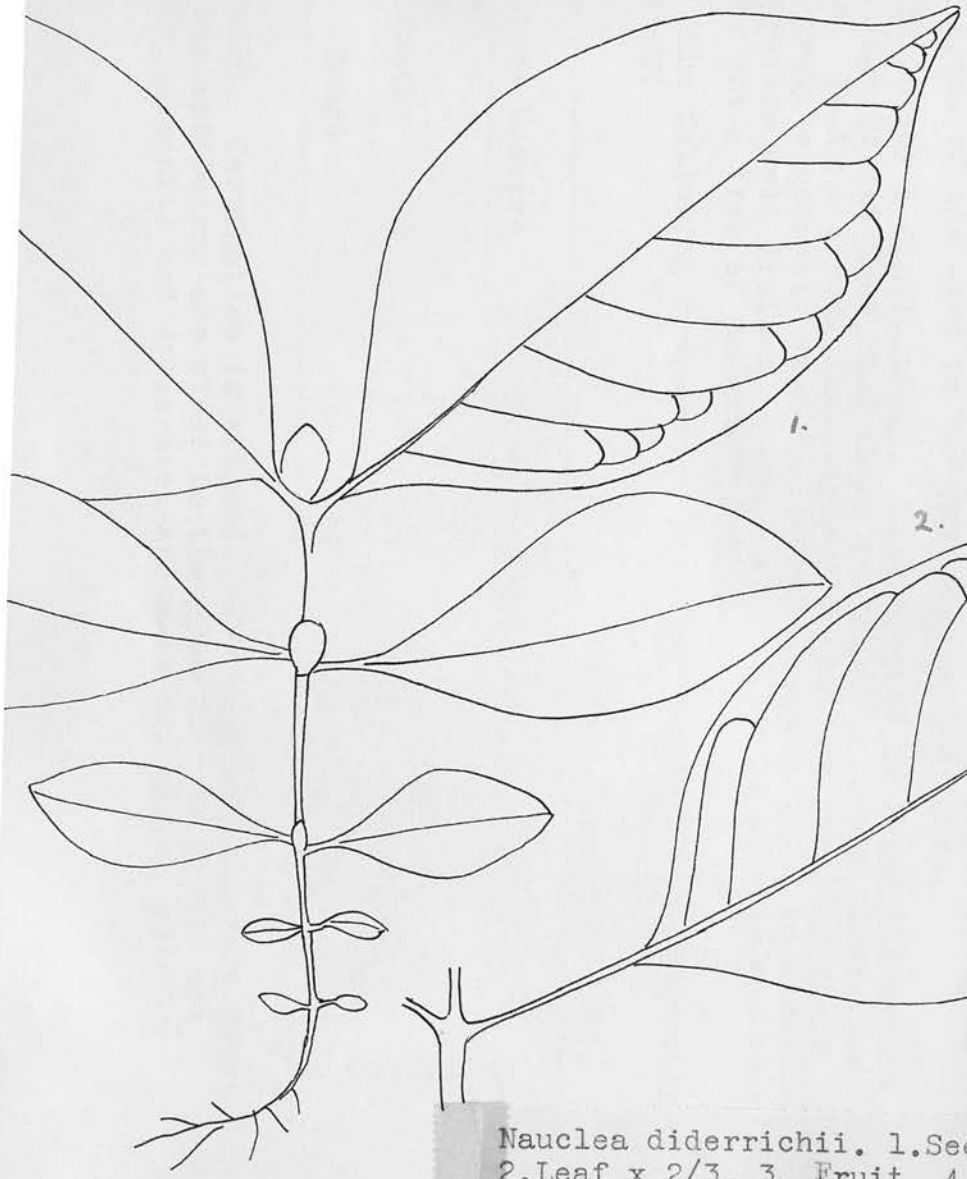
VERNACULAR NAMES. Bosima (S). Dubawile (Nz). Kusiaba (Nz). Kusia (Ash,T,W).

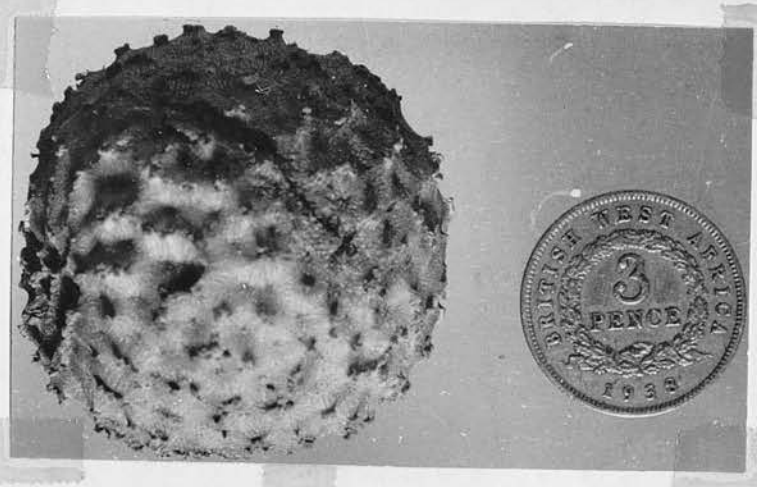
TRADE NAME. Opepe.

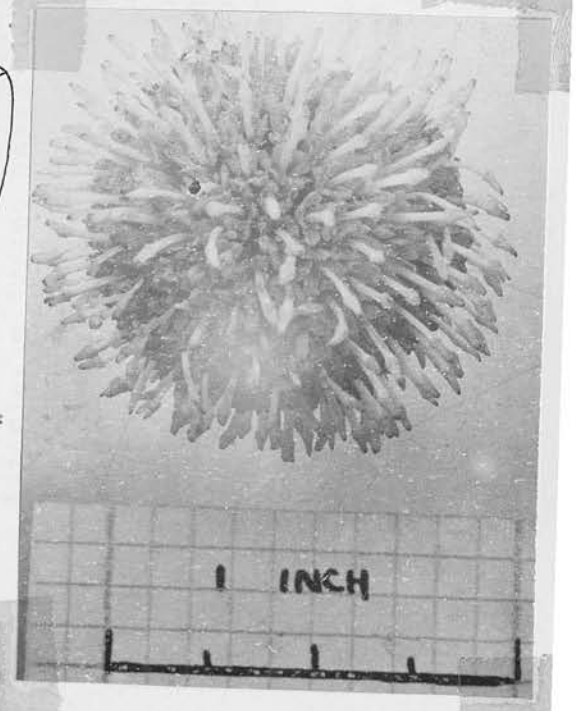
A large tree, sometimes bigger than the measurements of the felled trees given below:

Girth breast height	Length of bole	Height of tree
10ft. 10in.	93ft. 1in.	157ft. 0in.
14 5	97 3	157 9
17 2	83 7	143 1

The bole is tall, cylindrical, and without buttresses, although an occasional tree may be found with a flared base. For the size of the tree the rounded crown is comparatively small. The bark is a light brown, with thin scales, and the bole may be lumpy in appearance. The golden brown colour of the bark may assume a darker brown if the bole is in the open. The slash is thick, fibrous and saffron coloured. The sapwood is whitish. The heart is yellow or golden brown, sometimes flecked with a pinkish tinge, hard, moderately heavy, 47 lb. per cu. ft. at 15% moisture content, lustrous, usually with interlocked grain, and sometimes with a 'rope' figure which makes it decorative. It works quite well despite its hardness, and is resistant to fungi. In transverse section, many vessels are visible. The very numerous, very fine and close medullary rays can be seen with a hand lens. The wood is used for railway sleepers,







Nauclea diderrichii. 1.Seedling x 1.
2.Leaf x 2/3. 3. Fruit. 4.Inflorescence.

furniture, flooring, harbour works, bridges and in mines. It is an export timber. In 1934 a piece od wood of this species was recovered from the Akanko Mine, Axim District, after it had been underground for 30 years, and was found to be sound. This tree provides the most popular wood for making native mortars.

BOTANY. The leaves are simple, opposite and with caducous interpetiolar stipules. The leaf is elliptic, about 4 in. long and 2¼ in. broad (but considerably bigger in the young plant), entire, obtuse, cuneate, glabrous and with a slender petiole, about ¾-1 in. long, flattened above. The midrib and nerves are raised below. The stipule is broadly ovate to almost orbicular, about ¾ in. long, and glabrous. The capitate, scented inflorescences are in balls about 1 in. diameter. The flower is small and consists of a short, toothed, green calyx, a 5-lobed, yellow, corolla tube, 5 epipetalous stamens, and an inferior, 2-locular ovary with an exserted white style. The fruit is globose, about 1½ in. diameter, brown, fleshy and pitted. The seed is very small and light brown.

PHENOLOGY. The tree is evergreen. The main flowering season is May to August, but flowers have been collected at the end of February. Ripe fruits are available from September to December. They are eaten by animals and birds, but it is mainly the latter which distribute the seed. This is done very effectively as the sprea of the seed is far from the mother trees.

DISTRIBUTION & SILVICULTURE. This species is found throughout the High Forest Zone, but never in quantity in any particular area. It is a strong light demander from the seedling stage and grows vigorously when sufficient overhead light is available. It prefers well drained, light soils. This is an emergent tree. It is not a tree of Secondary Forest.

The following frequencies have been recorded in enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Subri	965	14	28	28	15	4
Fure	381	4	29	38	29	7
Bia South	734	35	29	13	6	2
Ayum	306	12	5	2	14	2
Atewa Range	573	17	29	30	24	12

SEEDLING. Germination is epigeal. The hypocotyl is very short and the cotyledons are close to the ground. The leaves are simple, opposite and decussate, and each succeeding pair is

bigger than the previous one. The large interpetiolar, almost orbicular stipules are prominent. The leaf in the 5th. pair is elliptic, about 4 in. long and 2 in. broad, entire, acuminate, cuneate, glossy green above, glabrous, and with a short petiole about ¼ in. long. The stem is green and succulent.

NATURAL REGENERATION. This is plentiful in openings in the forest, such as along logging tracks and in felling gaps. After a slow start, the seedlings grow fast if they obtain sufficent overhead light. An average annual increment is about 30 in. Where too open conditions exist, the seedlings are liable to insect borer attack, with the resulting death of the leading shoot. Multiple leaders are then formed. The mortality from what is quite abundant regeneration is high - from insect attack and lack of sufficient light.

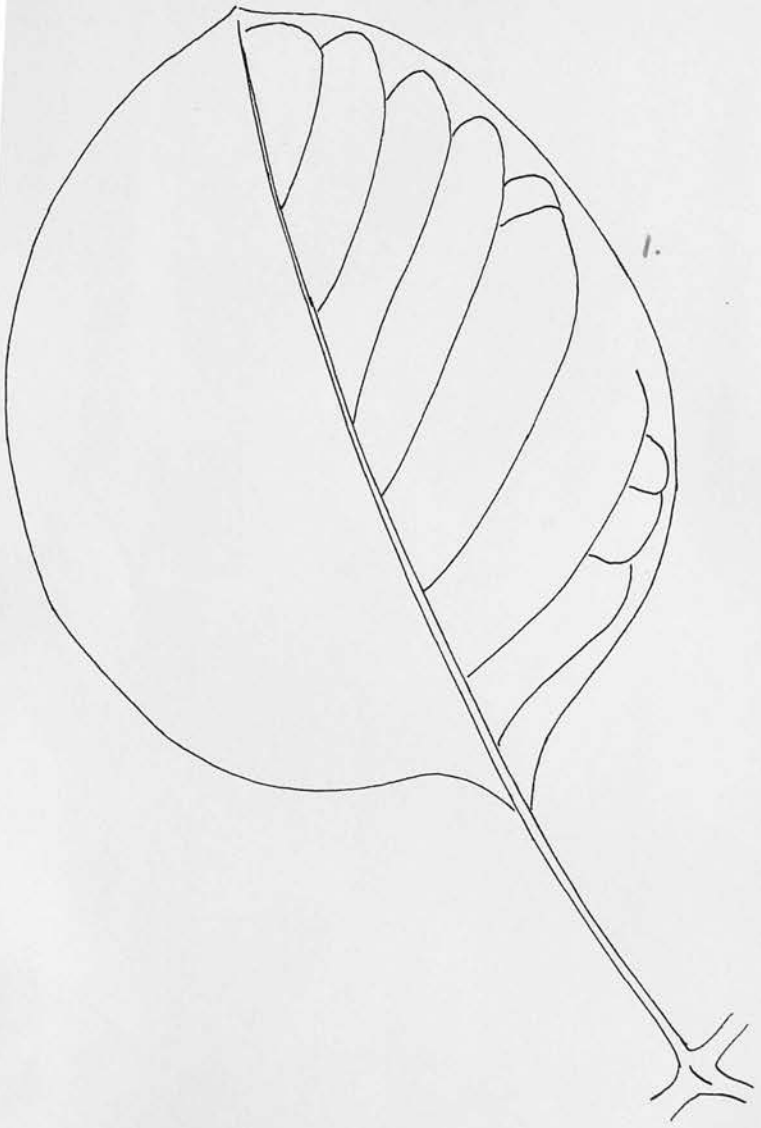
ARTIFICIAL REGENERATION. There are about 1,600 seeds to an ounce. Germination takes place in 14 days. As the seeds are very small, it is easier to break up the fruits in water and either dry them and sow, or pour the water and seeds onto the bed. The seedlings can be pricked out at about 6 weeks to 2 months and put in transplant beds. Because of the soft stem, care must be taken against wilting. It is advisable to have light screens over the transplant beds. Stumped plants are better for planting out - this again is because of the soft stem. Establishment is very good but the young plants are liable to insect borer attacks and leaf curl; if possible they should be given some side shade by controlling the weeds near them. Bushy plants tend to be developed for a while, and a planting espacement of not greater than 10 ft. X 10 ft. is necessary. There are no plantations of pole size or over of this species on the Gold Coast from which to quote measurements, but good results have been obtained at Akilla in Nigeria.

(ii) Nauclea pobeguinii (Hua ex Pob.) Merrill

SYNONYM. Sarcocephalus pobeguinii Hua ex Pobeguin

VERNACULAR NAMES. Sudua (Ash,W). Sukusia (T). Supawa (Ash).
Sukusia means the 'water Nauclea' - a reference to its habitat.

In general this is a smaller tree than N. diderrichii, but bears a resemblance to it, especially in the younger stages. The bark is smoother and has prominent lenticels. The slash is fibrous and saffron. The wood is softer, lighter in weight, and not so dark, and bitter. In transverse section, the vessels are hardly visible. The numerous, very fine, close medullary rays can be seen with a hand lens. The wood is not used for mortars because of its bitter tast being imparted to the food.



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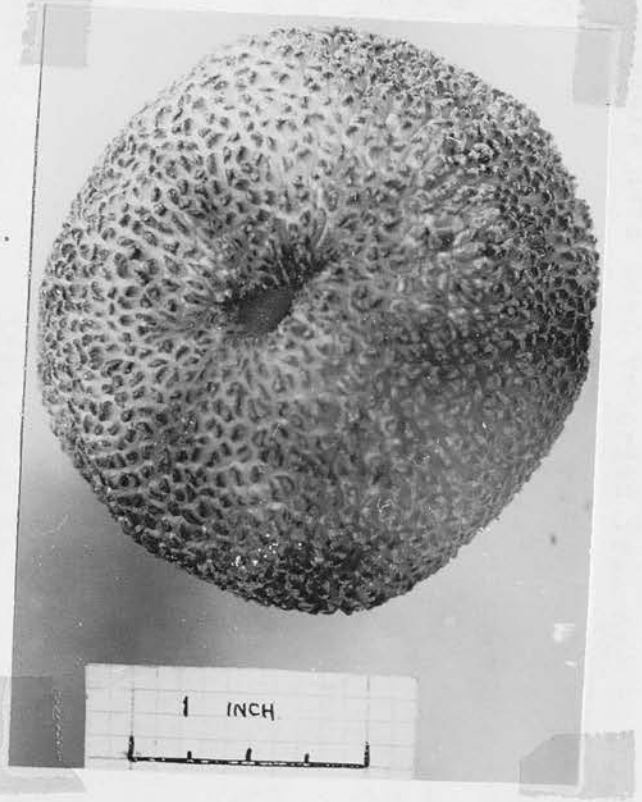


Nauclea pobenguinii.
1.Leaf x 1. 2.Fruit.

BOTANY. The leaves are similar to those of N. diderrichii, but are thinner, usually more broadly elliptic, about 5½ in. long and 4½ in. broad, and with a longer petiole - about 2 in. The fruits are larger - up to about 3 in. diameter. They have the smell of an over-ripe apple.

PHENOLOGY. Flowers have been recorded from May to July, and ripe fruits from September to November.

DISTRIBUTION & SILVICULTURE. N. pobeguinii is a tree of moist situations, such as freshwater swamps and the flood plains of rivers. It is found in such sites throughout the High Forest Zone, but is not common. It has been recorded from the Ankasa River and Subri F.Rs. in the Rain Forest, at Dunkwa, and as far north as the Pamu-Berekum F.R. in the Antiaris-Chlorophora Association of the Moist Semi-Deciduous Forest.

The following frequencies are from enumeration surveys. It may be mentioned that the Esukawkaw River F.R. is low lying and wet.

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Ankasa River	120	2	4	1	-
Esukawkaw River	1440	11	6	6	2

RUTACEAE.

A family which includes many small trees and shrubs. Some are armed with spines. The leaves are alternate or opposite, usually compound, often gland dotted and aromatic, and without stipules. The flowers are hermaphrodite or more rarely unisexual, and are 4- or 5-merous, with double the number of stamens. The ovary is superior and is rarely more than 5-locular. The fruit is various.

Besides the genus described below, the following small trees occur in the High Forest - Afraegle paniculata Engl., Araliopsis tabouensis Aubr.& Pellegr. and Citropsis articulata Swingle.

This family contains the well known fruits of the introduced genus Citrus L.

FAGARA L.

This genus consists of small trees which are armed with spines. F. xanthoxyloides Lam. is found in the Savannah-Woodland and in the Coastal Scrub and Grassland where it may be only a large shrub. Near water, as in Riverain Forest, it may grow into a much branched tree about 40 ft. high. F. melanacantha Engl. is a small tree in the High Forest Zone with large leaflets and black prickles.

SPECIES. (i) F. angolensis Engl. (ii). F. macrophylla Engl. (iii) F. parvifolium A.Chev.

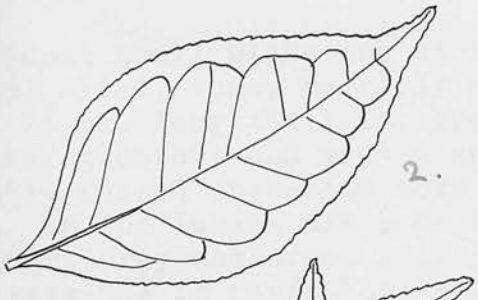
(i) Fagara angolensis Engl.

VERNACULAR NAMES. F. afzelii Engl. Xanthoxylum crenatum A.Chev. X. nitens Hiern

VERNACULAR NAMES. Bereboum (Wam). Oyia (Ash).

A tree reaching 60 ft. high and 6 ft. G.B.H., but often smaller, depending on its situation. The bole is usually short, not very straight and crowded with big corky spines (without pointed tips) on the lower part. There are no buttresses, but slight swellings at the base in old trees. The crown is not large but tends to spread a little. The bark is light grey. The slash is thick, dull yellow but with a bright yellow inner layer, and scented. It darkens to a dirty brown on exposure. The sapwood is yellow and lustrous.

BOTANY. The leaves are alternate, imparipinnate and exstipulate. The leaf is up to 15 in. long, and consists of about 7 pairs of sub-opposite or opposite leaflets and a terminal one. The rhachis is usually without spines, but there may be an



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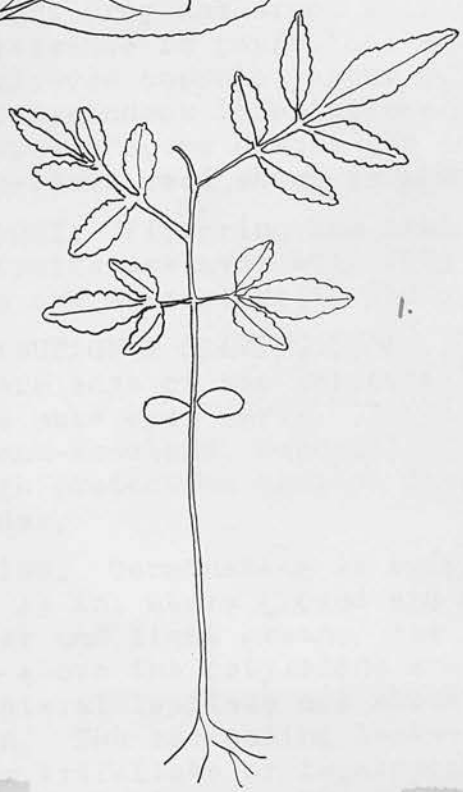

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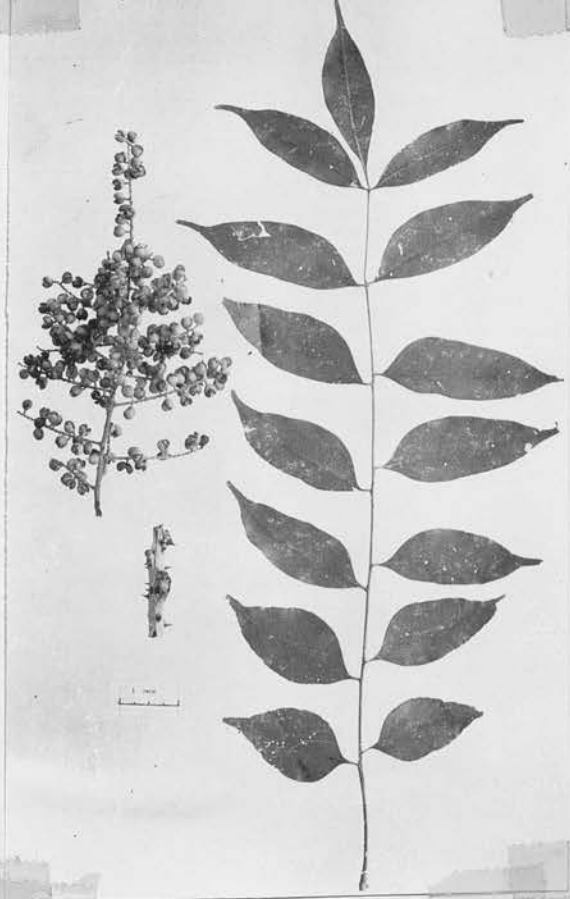

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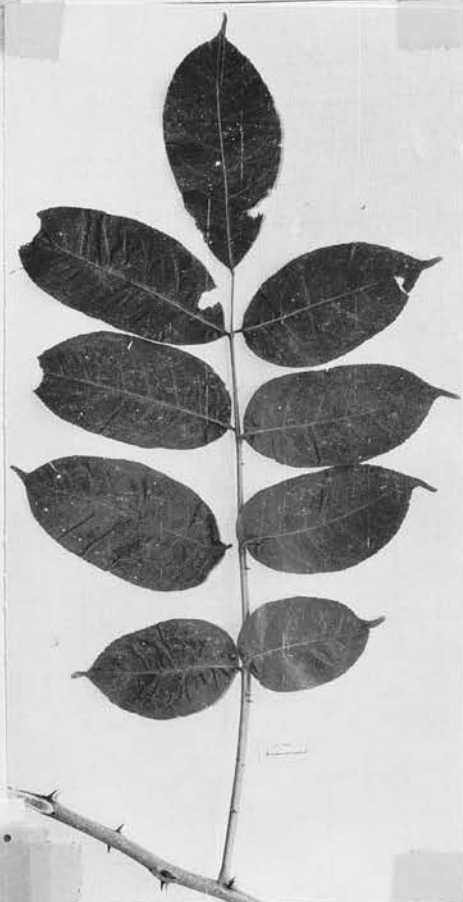


5.

Fagara angolensis. 1.Seedling x 1.
2.Leaflet x 1. 3. Flowers, leaf &
part of branchlet. 4.Bole.
F. melanacantha. 5.Leaf.

occasional small black one on the underside. The leaflet is unequal sided, thin, narrowly elliptic to oblong-lanceolate, about 2½ in. long and 1 in. broad, finely crenate, acuminate, cuneate, glabrous and with a short petiolule. The midrib is slightly raised above and more so below. The nerves are very fine. In the lamina are many golden pellucid glands. The branchlets are light grey and armed with short, sharp, black thorns. The inflorescence is paniculate and the flowers are unisexual. The fruit is a globose capsule, about 0.3 in. diameter, orange coloured, with conspicuous indentations because of glands, and sweet smelling. The capsule opens across the apex and exposes the solitary purple-black seed which is about 0.2 in. diameter.

PHENOLOGY. Flowering has been observed in June and July, and ripe fruits are available from August to October. The colourful fruits are attractive to birds, and the seeds are disseminated.

DISTRIBUTION & SILVICULTURE. F. angolensis is found along the northern edge of the Antiaris-Chlorophora Association, particularly in the more open parts. It is often a constituent of Derived Savannah-Woodland, especially where closed woodland is being formed through protection against fire. This species is a strong light demander.

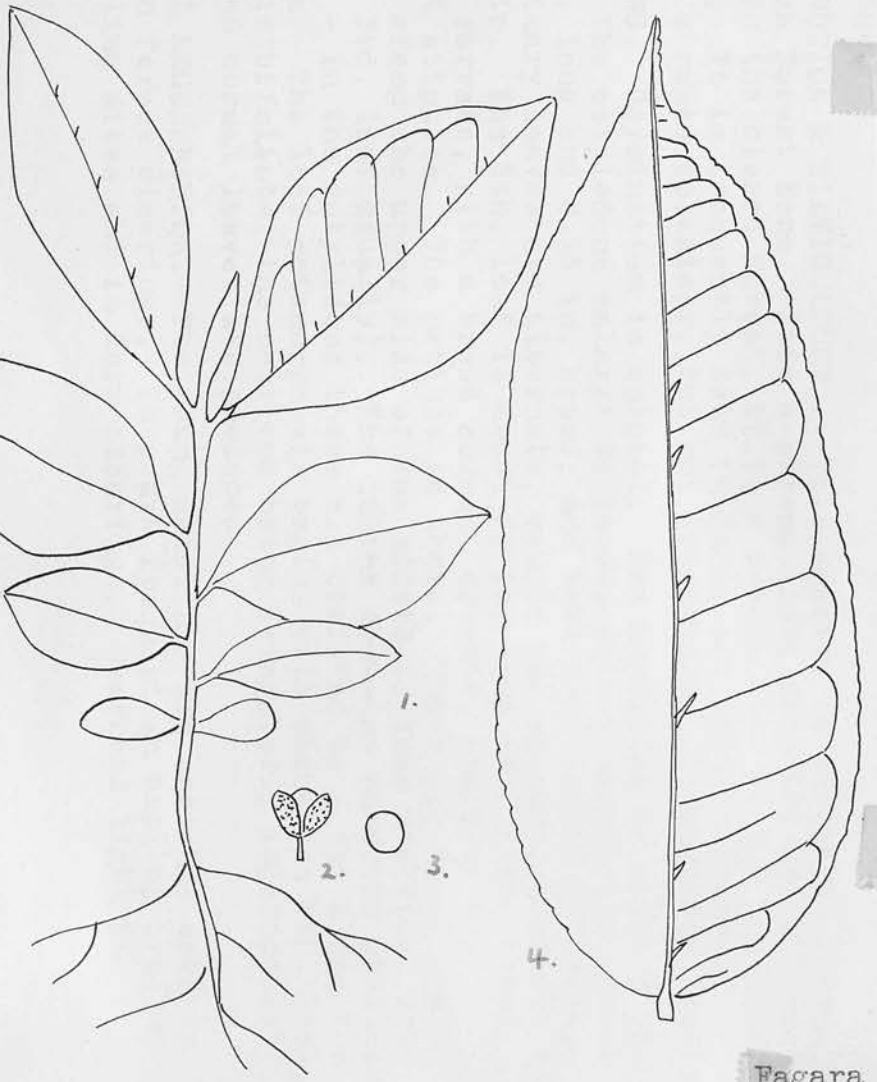
SEEDLING. Germination is epigeal. The sessile cotyledons are about 1½ in. above ground and do not develop. The hypocotyl is slender and light green. The first two leaves are borne about ½ in. above the cotyledons and are opposite and trifoliate. The lateral leaflets are about 0.4 in. long and the terminal one 0.6 in. The succeeding leaves are alternate. The 3rd. leaf is either trifoliate or imparipinnate - 2 pairs of opposite leaflets and a terminal one. The leaflets are oblong-lanceolate, serrate, covered in pellucid glands, emarginate, broadly cuneate but an attenuated base in the terminal one, sessile and exstipulate. The rhachis is slender and somewhat flattened. The shoot is green and slender. The entire seedling is glabrous.

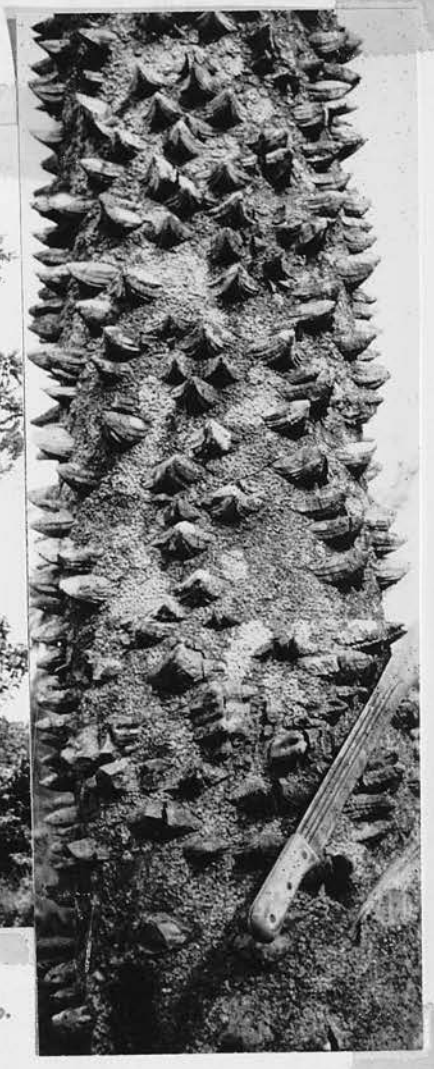
(ii) Fagara macrophylla Engl.

SYNONYM. Xanthoxylum macrophyllum Oliv.

VERNACULAR NAMES. Ainyan (Nz). Ainyere (Ao). Berebuno (Ash) Ehyerenkyen (S). Okuo (Ash). Oyea (Ash).

Although often seen in the open as a tree of about 50-80 ft. high, it may reach a height of 120 ft. and a girth of 9 ft. in closed High Forest. A felled specimen had a height of 101 ft., a bole length of 73 ft. and 5 ft. 7 in. G.B.H. The bole is straight, cylindrical and very slightly buttressed. The younger parts of the stem are armed with stout conical laminated spines with sharp points. The crown is rounded, small in the closed forest, but more spreading in the open, thin, with theleaves





Fagara macrophylla. 1.Seedling.
2.Fruit. 3.Seed. 4.Leaflet. All x 1.
5.Tree. 6.Bole.

crowded at the ends of the branches. The bark is grey and rugose, and the slash is thick, granular and light brown. The sapwood is white and lustrous. The heart is yellow, lustrous, hard, heavy, about 55-65 lb. per cu. ft. seasoned, durable and moderately difficult to work. The bark is boiled for chest medicines, and the spines are used for making signature stamps and for counters for the game of draughts.

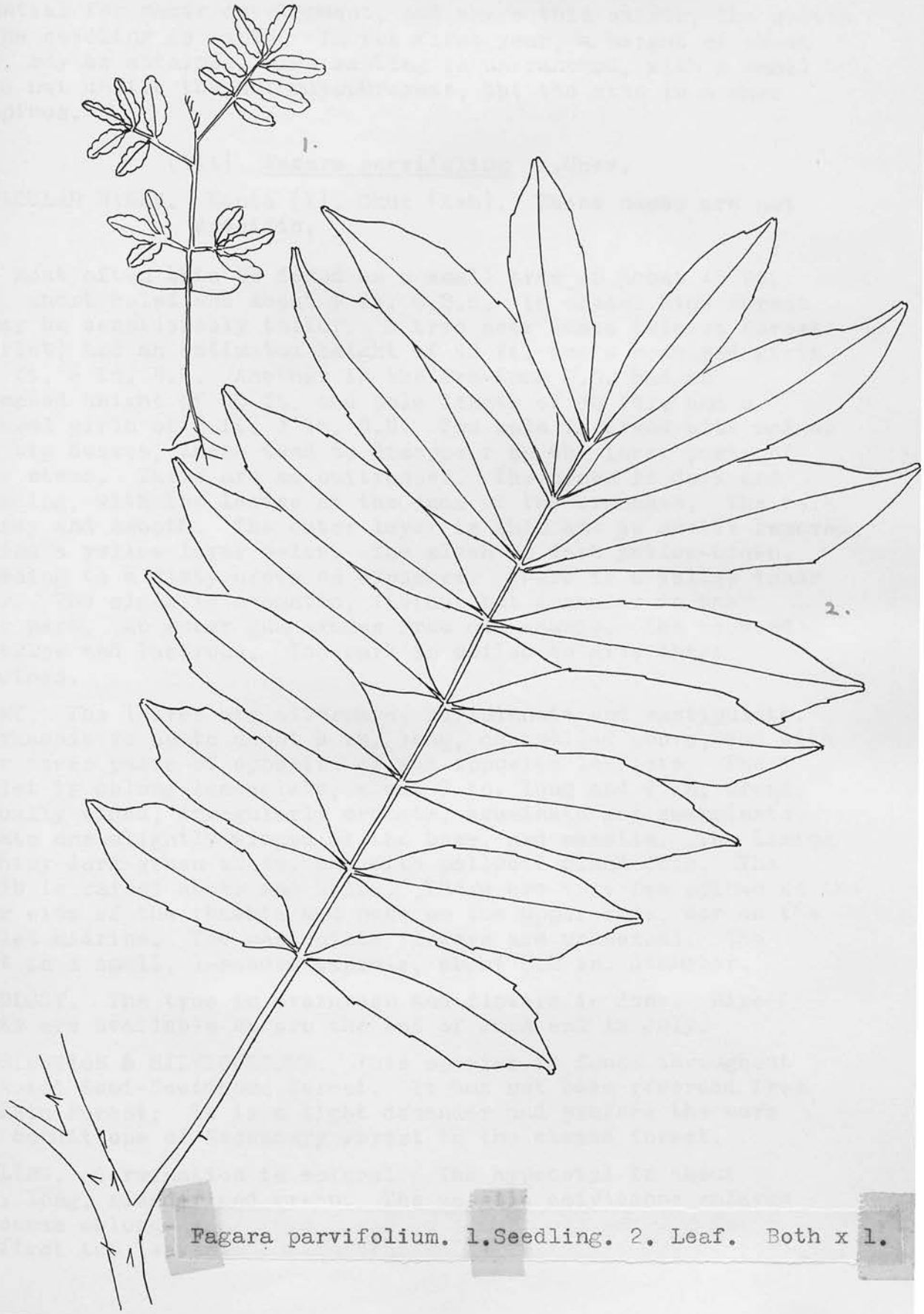
BOTANY. The leaves are alternate, imparipinnate, exstipulate, and large - up to about 30 in. long - with about a dozen opposite or sub-opposite leaflets and a terminal one, and glabrous. The leaflet is oblong-elongate, about 5½ in. long and 2 in. broad, crenate, acuminate, rounded or cordate at the base but sometimes asymmetrical. The petiolule is short and swollen. The lamina contains many pellucid glands. When bruised, the leaflet has the smell of an orange. There are spines on the rhachis and midribs (both sides), and stouter ones are crowded on the branchlets and young shoots. The inflorescences are in panicles and the flowers are unisexual. The fruit is a globose capsule about 0.2 in. diameter, dark brown, gland punctate and opening across the apex. There is usually 1 black seed to a fruit.

PHENOLOGY. The tree is evergreen. Flowers have been observed in June and fruits in June and July. Flowers and fruits are not conspicuous, and so it is likely that their periods extend beyond those given here. Seed distribution is by birds and this is very efficient, judging by the number and spread of the seedlings.

DISTRIBUTION & SILVICULTURE. This species is scattered throughout the High Forest Zone. Itis a strong light demander and although found in the closed forest, it is a common tree of the Secondary Forest. It is frequently seen in farms and other clearings, and is a rapid coloniser, but not gregarious. It coppices freely.

SEEDLING. Germination is epigeal. The hypocotyl is about ½ in. long. The cotyledons enlarge to become oblong-lanceoalte, about 0.4 in. long and 0.15 in. broad, and have very slight petioles. The primary leaves are alternate, simple and oblong-lanceolate to elliptic. The 5th. leaf is about 2½ in. long and 1¼ in. broad, finely serrate, with a broad acumen, cuneate, glabrous and without stipules. The petiole is short. There are fine, short spines along the upper side of the midrib (spines are first seen on the 3rd. leaf usually). The lamina contains numerous pellucid glands - in the cotyledons these are confined to a row along the margins. The leaf metamorphosis begins with about the 8th. leaf, which is bifoliate, the next one being irregularly imparipinnate, and then normal leaves are produced.

NATURAL REGENERATION. The young seedlings are commonly seen in June in forest clearings. They are frequent on hauling tracks, on felling sites and in farm clearings. Overhead light is



Fagara parvifolium. 1.Seedling. 2. Leaf. Both x 1.

essential for their development, and where this exists, the growth of the seedling is rapid. In its first year, a height of about 3 ft. may be attained. The sapling is unbranched, with a small crown not unlike the Entandrophragmas, but the stem is a mass of spines.

(iii) Fagara parvifolium A.Chev.

VERNACULAR NAMES. Kanto (T). Okuo (Ash). These names are not specific.

Most often this is found as a small tree of about 45 ft. high, short boled and about 5 ft. G.B.H. In closed High Forest it may be considerably taller. A tree near Amoya (Wiawso Forest District) had an estimated height of 90 ft. and a measured girth of 5 ft. 6 in. B.H. Another in the Pra-Anum F.R. had an estimated height of 80 ft. and bole length of 30 ft., and a measured girth of 6 ft. 3 in. B.H. The bole is armed with spines with big bosses; these tend to disappear on the lower parts of older stems. There are no buttresses. The crown is dark and spreading, with the leaves at the ends of the branches. The bark is grey and smooth. The outer layer is thin and is easily removed, leaving a yellow layer below. The slash is dark yellow-brown, darkening to a dirty brown on exposure. There is a yellow inner layer. The slash is aromatic, fibrous but granular in the outer part. An amber gum exudes from old wounds. The sapwood is yellow and lustrous. The bark is boiled to give chest medicines.

BOTANY. The leaves are alternate, paripinnate and exstipulate. The rhachis is up to about 9 in. long, channelled above, and with 18 or fewer pairs of opposite or sub-opposite leaflets. The leaflet is oblong-lanceolate, about 2 in. long and $\frac{3}{4}$ in. broad, unequally sided, irregularly crenate, acuminate and emarginate, cuneate ans slightly winged at the base, and sessile. The lamina is shiny dark green above, and with pellucid gland dots. The midrib is raised above and below. There are very few spines on the under side of the rhachis and none on the upper side, nor on the leaflet midribs. The paniculate flowers are unisexual. The fruit is a small, 1-seeded capsule, about 0.2 in. diameter.

PHENOLOGY. The tree is evergreen and flowers in June. Ripe fruits are available before the end of June and in July.

DISTRIBUTION & SILVICULTURE. This species is found throughout the Moist Semi-Deciduous Forest. It has not been recorded from the Rain Forest. It is a light demander and prefers the more open conditions of Secondary Forest to the closed forest.

SEEDLING. Germination is epigeal. The hypocotyl is about 1 in. long, slender and green. The sessile cotyledons enlarge to become oblong-lanceolate, about 0.4 in. long and 0.1 in. broad. The first two leaves are borne about 0.4 in. above the cotyledons

and are opposite and trifoliate. The succeeding leaves are alternate and imparipinnate. The leaflet is oblong-lanceolate, about ½ in. long and 0.2 in. broad, crenate, emarginate and sessile. There are pellucid glands on the flattened rhachis, along the leaflet margins, especially at the bases of the crenations, and along the margins of the cotyledons. The seedling is glabrous.

SAMYDACEAE.

A family of trees and shrubs. The leaves are alternate, simple and stipulate. The flowers are hermaphrodite, perigynous and with a unilocular ovary. The fruit is dry and capsular or indehiscent. From a forestry aspect, this is not an important family.

HOMALIUM Jacq.

SPECIES. (i) H. dolichophyllum Gilg. (ii) H. molle Stapf (iii) H. neurophyllum Hoyle

(i) Homalium dolichophyllum Gilg.

SYNONYM. H. africanum Gilg.

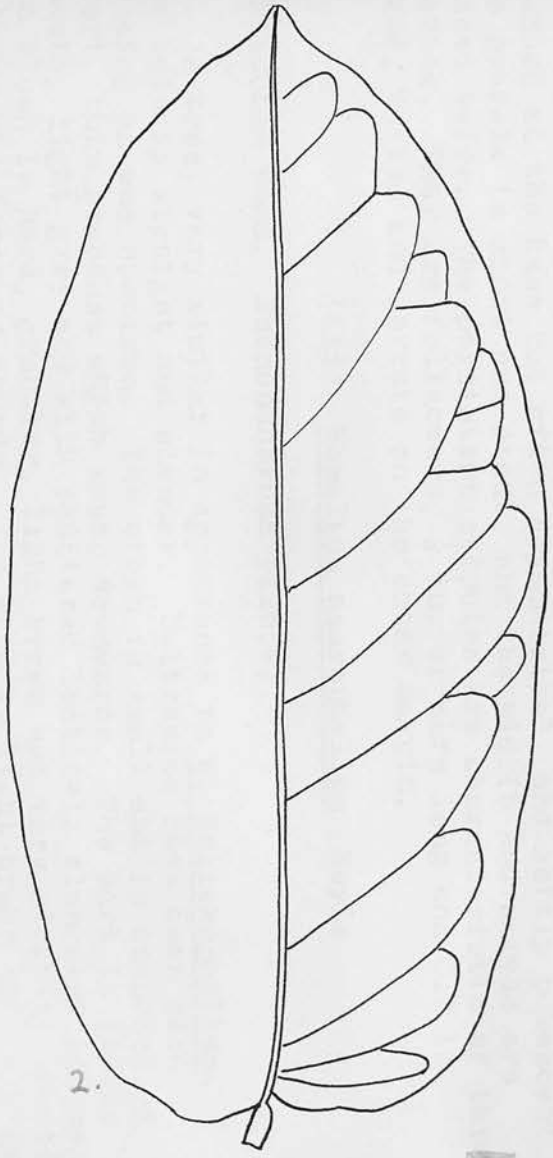
VERNACULAR NAMES. Duakowaboba (Ash). Esononankroma (Ash.W). Mepumdua (Ash). Miarire (Nz).

A tree seldom bigger than 80 ft. high and 6 ft. G.B.H. The bole is slender and straight, with a small crown composed of thin branches, which are quite short and sweep downwards. In the pole stage the crown is deep and spreading, and entirely different from the crown of the older tree. The bark is dark grey, and the slash is granular, light brown but darkening on exposure. The sapwood is light brown and hard. The heart is light brown, heavy, hard and with a moderately fine texture. In transverse section, the parenchyma surrounding the vessels is easily discernible. The numerous vessels can be seen with a hand lens, and also the medullary rays, which are of two widths - 2 to 5 fine to a broad one.

BOTANY. The leaves are alternate, simple and the stipules are deciduous. The leaf is oblong to oblong-elliptic, about 6 in. long and 3 in. broad, or sometimes about 12 in. long and 5 in. broad, serrate but undulate in old trees, with a short acumen, cordate, glabrous, shiny below, coriaceous, with a short, stout petiole about 0.3 in. long. The midrib and nerves are raised below. The flowers are in large terminal panicles and are 5- or 6-merous. The fruit is characteristic of the genus. The sepals are persistent and the petals become accrescent and and coral coloured and act as wings to the fruit.

PHENOLOGY. The tree is evergreen. The new leaves are red at first and then become dark green. Flowering takes place in September - November, but is less conspicuous than the fruiting period of November to March. The fruits are wind distributed.

1.



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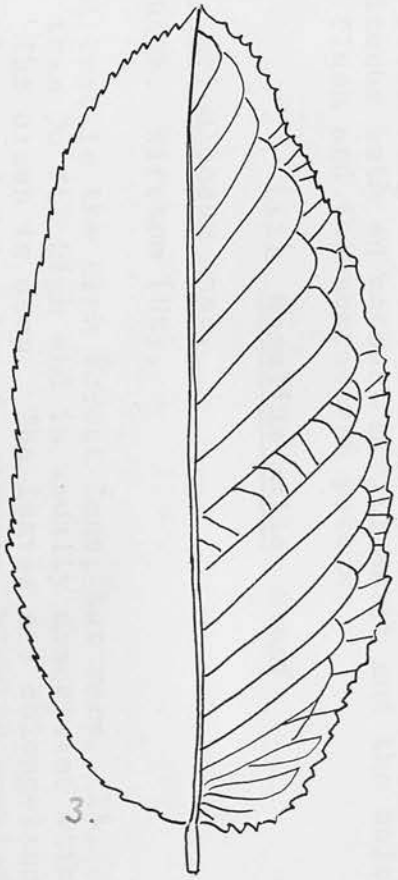

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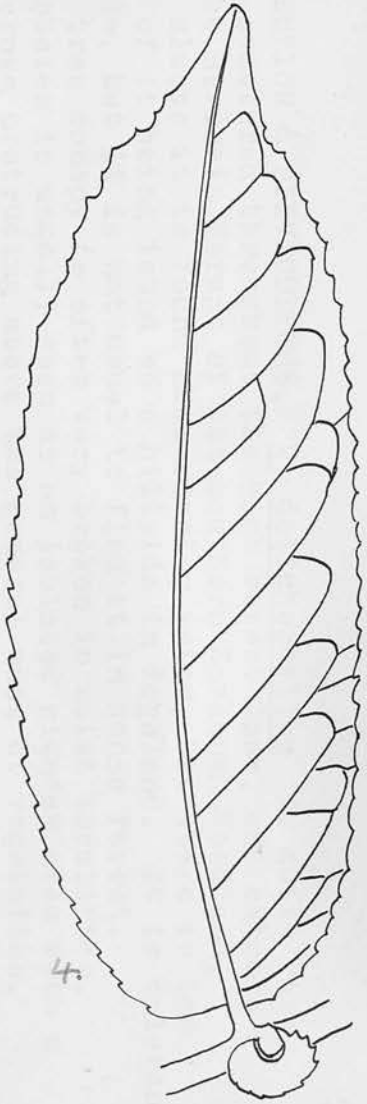


4.

Homalium dolichophyllum. 1.Tree. 2.Leaf x 1.
H. neurophyllum. 3.Leaf x 1. H. molle. 4.Leaf x 1.

DISTRIBUTION & SILVICULTURE. H. dolichophyllum is quite rare, but is scattered throughout the High Forest Zone, and extends into the Riverain Forest of the southern Savannah-Woodland. Almost always it is found near running water, but there is the record of it being found on a hillside in Togoland. It is tolerant of shade, but it is not usual to find it in dense forest. As the tree canopy is often very broken in moist localities, this species is usually seen as an isolated slender stem with a small crown protruding above the general mass of vegetation. It is conspicuous both on account of its habit and the coloration of the leaf flush and the accrescent petals.

(ii) Homalium molle Stapf

SYNONYM. H. stipulaceum Mast.

VERNACULAR NAME. Wirokom (Nz).

A small tree in the High Forest Zone, but rare. It is seldom more than 30 ft. high and is usually associated with wet situations. The crown is deep. The leaves are oblong-lanceolate, about 5½ in. long and 2 in. broad, serrate, bluntly acuminate, rounded at the base but often asymmetrical, and softly pubescent. The petiole is short and stout, and the midrib and nerves are raised below. The persistent stipules are characteristic of this species. They are foliaceous, ½ in. or more long and 0.2 in. broad, curved and serrate on the outer margin.

(iii) Homalium neurophyllum Hoyle

VERNACULAR NAME. Esononankroma (Ash,W).

A tree, very similar in appearance to H. dolichophyllum. The bole is straight and slender. Buttresses have been seen forming on one specimen. The crown is small and is composed of short, thin branches which sweep downwards. The bark is fairly smooth, light grey and with scattered lenticels elongated laterally. The slash is hard, granular, light brown and very slightly scented. A brown gum forms on wounds. The wood is light brown and very hard.

BOTANY. The leaves are simple and alternate, and the stipules are deciduous. The leaf is oblong-elliptic, about 4½ in. long and 2½ in. broad, serrate, with a short acumen, rounded at the base, coriaceous, shiny above and dull below, slightly pubescent at first but glabrous later. The petiole is about 0.3 in. long. The midrib, nerves and veins are raised below.

DISTRIBUTION. Found in the High Forest Zone, but rare. Specimens have been recorded from the Subri F.R. to the Southern Scarp F.R.

SAPINDACEAE.

A family of trees, shrubs and climbers, but in the Gold Coast flora mostly represented by small trees. The leaves are usually alternate and pinnate. Most of the flowers are unisexual. The sepals and petals are 5-merous or 4-merous; the stamens are often 8, and although apparently developed in the female they have infertile pollen; the syncarpous superior ovary is 4-locular usually. In most cases the fruit is capsular.

Paullinia pinnata L. is a climber found throughout the Gold Coast. Harpullia fosteri Sprague is a small tree which may reach a height of 80 ft. Small trees and shrubs of Allophylus L., which have trifoliate leaves, are found in the transition belt between the high Forest and the Savannah-Woodland, and between the High Forest and the Coastal Scrub and Grassland. Laccodiscus Rdlk., Lecaniodiscus Planch. and Placodiscus Radlk. are common small trees of the understorey of the High Forest Zone.

GENERA. 1. Blighia Koenig 2. Phialodiscus Radlk.

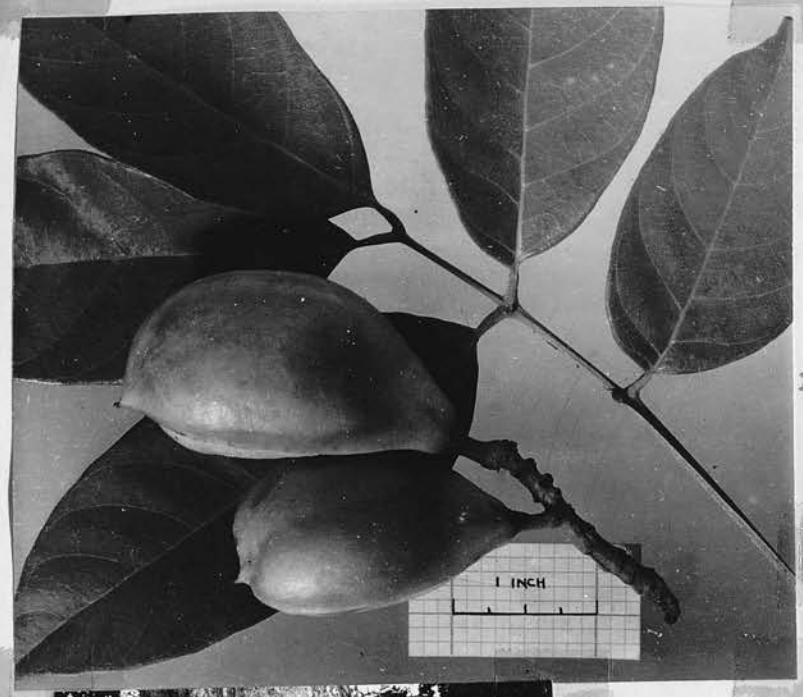
Morphological features of these two genera are similar.

1. BLIGHIA Koenig

Blighia sapida Koenig

VERNACUALR NAMES. Adza (E). Akaa (Brong). Akye (Ash,F,T,W). Akye-fufu (T). Takwadua (T,W). Akye-fufu means the white Akye - cf. Phialodiscus.

A medium sized tree. A felled specimen had a height of 104 ft., a bole length of 70 ft. and 8 ft. 9 in. G.B.H. sometimes a large specimen is seen, as the one in the Pra-Anum F.R., with an estimated height of 130 ft. and a measured girth of 19 ft. 7 in. B.H. The bole is not cylindrical and although not buttressed, it develops root spurs. The crown is dark, dense, deep but not very spreading, and the branches are heavy. The bark is fairly smooth, sometimes slightly rough, grey-green, and with many lenticels. The slash is hard, thick, granular, yellowish-brown, speckled and slightly scented. The sapwood is hard and dull yellowish-brown. The heart is dark red-brown, hard, heavy, about 55 lb. per cu. ft. at 13% moisture content, moderately coarse texture, shrinks considerably and has a tendency to check and warp on seasoning. The tree is planted in villages, even in the far north of the Gold Coast, as at Navrongo, as shade trees. The aril is eaten, but may be poisonous if immature or over-ripe.



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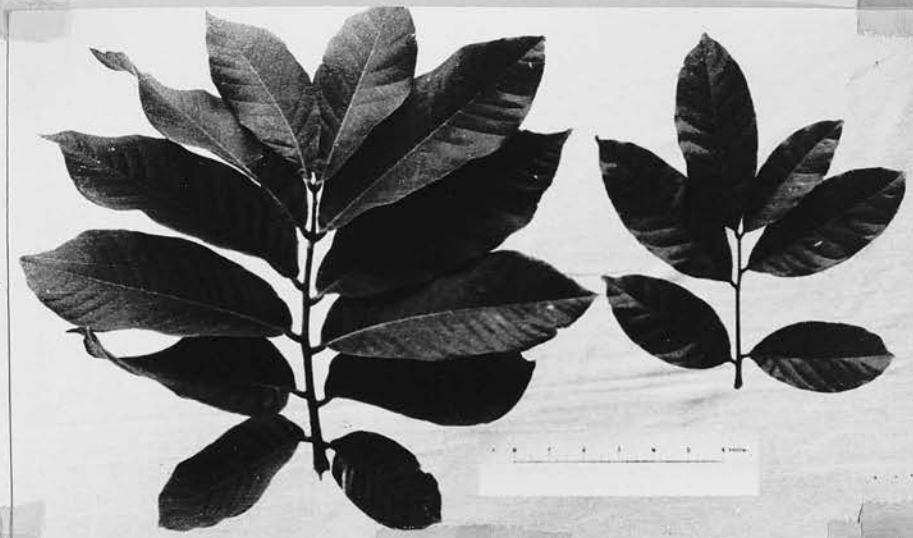

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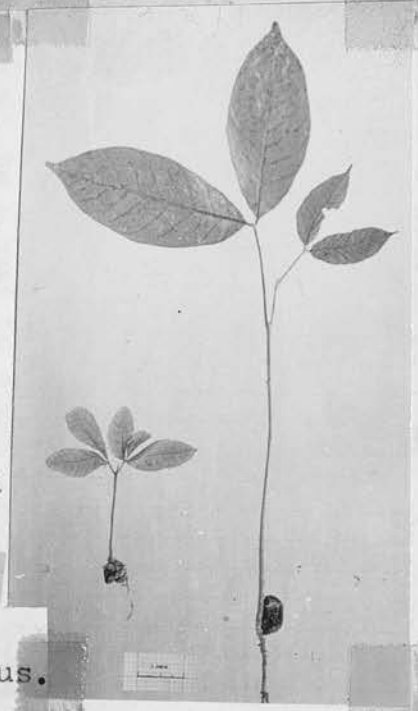


4.

7.

Blighia sapida. 1.Bole. 2.Leaf & fruits,
3.Leaf. 4.Seedling. Phialodiscus unijugatus.
5.Fruits. 6.Leaf. 7.Seedling.

BOTANY. The leaves are alternate and paripinnate. The rhachis is about 5 in. long and the dark brown, velvety covering persists for quite a while. There are 3-6 pairs of opposite or sub-opposite leaflets. The basal pair is often close to the base of the rhachis. The leaflet is obovate-elliptic, anout 4½ in. long and 2 in. broad, entire, obtuse to almost rounded, broadly cuneate, sometimes asymmetric at the base, dark shin green above and with a slight yellow pubescence below. The petiolule is short, stout and dark brown tomentose. The midrib and nerves are raised below and are prominent, and so are the veins to a lesser degree. The small white flowers are in axillary racemes up to about 9 in. long. There are 5 sepals, 5 petals, 8 stamens, and a superior 3-locular ovary. The fruit is a red to orange coloured fleshy capsule, about 2 in. long, trilobed, opening at the apex by 3 valves and exposing the 3 seed. The seed is blck, shiny, about ¾ in. long and ½ in. wide, and with a yellow aril at the base.

PHENOLOGY. The tree is evergreen. The new leaves appear with a bronze flush. Flowering and fruiting are irregular. Flowers have been recorded from August to April, and fruits from january to September. Flowers and fruits may be found on the same tree. The seeds and fruits are eaten by duikers and rodents on the ground, and by the bigger birds on the trees. When the tree is in fruit it is very picturesque.

DISTRIBUTION & SILVICULTURE. This species is well distributed throughout the Moist Semi-Deciduous Forest; it also occurs in the Riverain Forest of the southern Savannah-Woodland. There is no record of it from the Rain Forest. Blighia is shade tolerant and will grow slowly and steadily in the closed High Forest In more open conditions the sapling may put on an annual height increment of up to 2 ft. In general, the tree prefers the drier sites in the forest. It is this character, probably, which allows it to be successfully grown in such dry places as Navrongo market and in villages in Northern Togoland.

SEEDLING. Germination is hypogeal. The cotyledons do not emerge. The first two primary leaves are borne about 4-5 in. above ground and are opposite and either bi- or tri-foliate. The rhachis is about 1¼ in. long. The leaflet is oblong-lanceolate to oblong-elliptic, about 2½ in. long and 1 in. broad, entire, acuminate, cuneate, and with a short, petiolule about 0.15 in. long. The shoot, rhachides, petiolules, midribs and nerves (both sides) are slightly pubescent or villous. The succeeding leaves are alternate. The change to paripinnate leaves is not immediate.

NATURAL REGENERATION. This is not uncommon, especially in fairly open places, such as farms, in May to July. The seedlings seem to be indifferent to open or shaded conditions.

ARTIFICIAL REGENERATION. There are about 21 seeds to an ounce, or 12 with arils. Germination is good, and is usually about 80%. The germination period is about 10 days. In the first year the seedlings reach about 15 in. high.

2. PHIALODISCUS Radlk.

Phialodiscus unijugatus Radlk.

SYNONYM. Blighia unijugata Bak.

VERNACULAR NAMES. Akyebiri (Ash,T). Akyetabon (T). Akyewa (Ash). Edwundwuna (W). Akyebiri means the black Akye - cf. Blighia.

Often a small tree, but capable of attaining about 90 ft. high, with a girth B.H. of 6 ft. The bole is not buttressed and may be quite short. The crown is dark, deep, untidy and much branched. The bark is dark and fairly smooth. The slash is granular and light brown. It is similar to thatof Blighia but appears to be darker and not as thick. The sapwood is white. The heart is light brown, fairly hard and heavy. In transverse section the small scattered vessels are just visible. The very many fine medullary rays can be seen by means of a hand lens.

BOTANY. The leaves are alternate and paripinnate, with usually 2-3 pairs of opposite or sub-opposite leaflets similar to those of Blighia. The leaflet is oblong-elliptic, about 6 in. long and $2\frac{3}{4}$ in. broad in the apical pair, and about 3 in. long and $1\frac{3}{4}$ in. broad in the basal pair, entire, broadly acute, cuneate, glabrous but for a few hairs in the nerve axils. The midrib and nerves are raised below but the veins are not quite so prominent as those of Blighia. The scented flowers are similar to those of Blighia but the axillary racemes are usually shorter. The fruit is a red, fleshy, 3-angled capsule, opening at the apex by 3 valves and containing 3 black, shiny seed, about 0.4 in. long, and each with an orange aril at the base, as long as the seed itself.

PHENOLOGY. The tree is evergreen. Flowering takes place from August to December, and fruiting grom February to May. The tree in fruit is attractive. The fruits and seeds are eaten by birds and small animals.

DISTRIBUTION & SILVICULTURE. The tree is found throughout the Moist Semi-Deciduous Forest, but has not been recorded from the Rain Forest. It is a shade bearer but will also grow in the more open situations. It prefers fairly dry ground. Its frequency, although never great, seems to increase towards the northern part of the High Forest.

SEEDLING. Germination is hypogeal. The first two leaves are borne about 2 in. above ground; they are opposite, simple, elliptic, about $2\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. broad. The succeeding leaves are alternate - the 3rd. and 4th. leaves are bifoliate, and paripinnate leaves are developed later. In the 3rd. the rhachis is about 0.6 in. long. The leaflet is oblong-elliptic, about $1\frac{1}{2}$ in. long and 0.6 in. broad, entire, acute, almost rounded at the base, light shiny green, and with a very short

petiolule. The shoot, rhachis and undersides of the nerves are very slighly pubescent.

ARTIFICIAL REGENERATION. There are about 52 seeds, without arils, to the ounce. The germination period is about 18 days.

FIELD NOTES. An attempt is made here to separate Blighia and Phialodiscus for field identification.

Character	Blighia	Phialodiscus
Slash	Thick	Thinner
Leaf tip	Obtuse	Acute
Lamina - below	Pubescent	Sparsely pubescent
Nerves	Looped	Often not looped
Veins - below	Prominent	Less prominent
Fruit	2in. long	1-1½ in. long
"	Angles rounded	Angles sharp.

SAPOTACEAE.

A family of trees, mostly with latex, and simple, often coriaceous, alternate leaves, without stipules usually. The nerves are sometimes fine and numerous. The small flowers are hermaphrodite, and consist of 4-8 sepals, 4-8 petals generally in a corolla tube and caducous, and a superior often 5-locular ovary. The fruit is a berry with one or few seeds and rarely many. The cotyledons are usually foliaceous.

In the Savannah-Woodland is Butyrospermum parkii Kotschy, the Shea Butter Tree; it is important because of the food value of its fruits. Malacnatha alnifolia Pierre is a shrub or small tree in the transition belt from High Forest to Savannah- Woodland and in the Coastal Scrub and Grassland. Manilkara Rheede has a similar distribution. Pachystela Pierre and Synsepalum dulcificium Daniell are small trees of the High Forest. Breviea sericea Aub.& Pellegr. is a tree not unlike a Chrysophyllum L.

GENERA. 1. Aningueria Aub.& Pellegr. 2. Chrysophyllum L.
3. Mimusops L. 4. Omphalocarpum P.Beauv.

1. ANINGUERIA Aub.& Pellegr.

SPECIES. (i) A. altissima Aub.& Pellegr. (ii) A. robusta Aub.& Pellegr.

The two species are very similar in habit and are not separated by the natives. Below, only A. robusta is given in detail, for many of the characters are common to both.

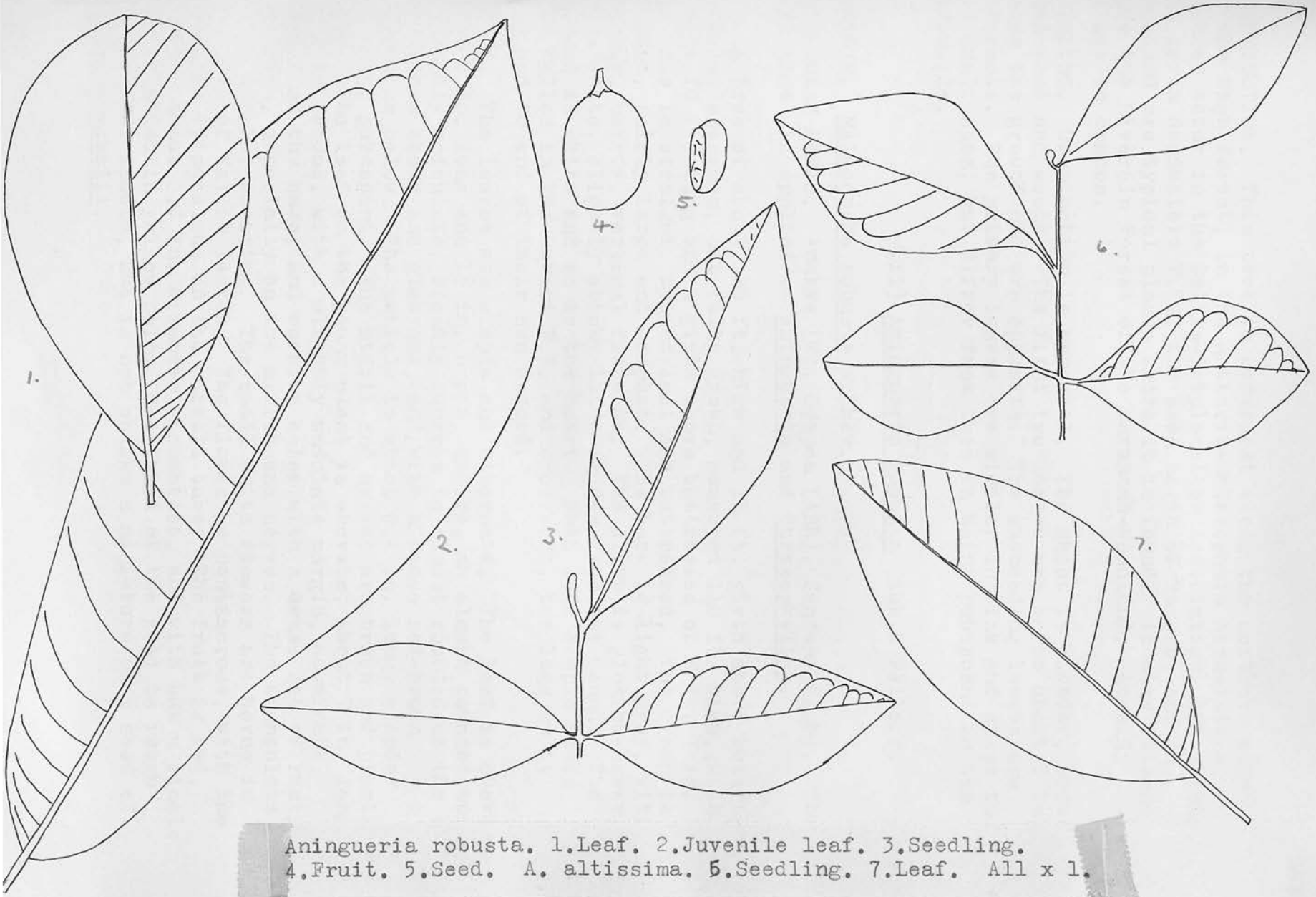
(i) Aningueria altissima Aub.& Pellegr.

SYNONYM. Sideroxylon altissimum Hutch.& Dalz.

VERNACULAR NAMES. Apotoru (Ash). Sanfena (Ash). This second name is applied generally to Aningueria and Chrysophyllum.

BOTANY. The leaves are alternate, simple, shiny green, very slightly pubescent at first below but soon becoming glabrous. The leaf is oblong-elliptic, about 3 in. long and 1½ in. broad, entire, broadly acute, broadly cuneate to almost rounded, with a slender brown petiole about ½ in. long and channelled above. The midrib and nerves are prominent below and the latter are yellow or light brown and almost parallel with one another. The venation is reticulate. The flowers are borne in the leaf axils near the ends of the branchlets.

PHENOLOGY. Flowering takes place in December and January, and ripe fruits are available from March to May.



Aningueria robusta. 1.Leaf. 2.Juvenile leaf. 3.Seedling.
4.Fruit. 5.Seed. A. altissima. 6.Seedling. 7.Leaf. All x 1.

DISTRIBUTION. This tree is commonest along the northern edge of the High forest, in the Antiaris-Chlorophora Association. It does occur in the Celtis-Triplochiton Association, but rarely. The Afram Headwaters F.R., the area north of Begoro, and in Togoland are typical places where it is found. It also extends into the Riverain Forest of the Savannah-Woodland. Locally it may be common.

SEEDLING. Germination is hypogeal. The shoot is slender, brown, pubescent and woody. The first two leaves are borne about 5 in. above the ground and are opposite. The succeeding leaves are alternate. The primary leaves are similar in size and shape to the adult ones, but differ from them in being pubescent on the underside.

(ii) Aningueria robusta Aub.& Pellegr.

SYNONYM. Malacantha robusta A.Chev.

VERNACULAR NAMES. Anakye (W). Opapea (Ash). Sanfena (Ash). The last name is applied to Aningueria and Chrysophyllum.

A tree of about 120 ft. high and 11 ft. girth above buttresses. A felled specimen, not fully grown, measured 110 ft. high,,with a bole 70 ft. long and a girth above buttresses of 8 ft. 7 in. The bole is straight, cylindrical and buttressed. The crown is rounded, fairly large and compact. The bark is light grey, with regular, narrow, vertical fissures. The slash is pinkish-brown, and a white, slightly sticky latex exudes from the wound. The sapwood is white and so is the heart. When some sample trees were felled in the Bobiri F.R. and cross-cut, the logs split from end to end of their own accord.

BOTANY. The leaves are simple and alternate. The leaf is obovate, about 3 in. long and $1\frac{3}{4}$ in. broad, entire, an almost rounded apex or broadly apiculate, broadly cuneate to almost rounded at the base, dull green above and glabrous, and with a dense red-brown indumentum below. The petiole is about 0.4 in. long, slender and rusty pubescent. The midrib and nerves are brown and prominent below. The leaf on the young plant is obovate, about 7 in. long and 3 in. broad, with a slightly undulate margin, acuminate, rounded at the base, and covered below with a dense mat of rusty red hairs, especially on the midrib and nerves. The branchlets have a similar covering. The small white flowers are borne in the axils of fallen leaves. The flower is pentamerous, with the 5 stamens epipetalous on the corolla tube. The fruit is red, globose, about 0.7 in. diameter, tomentose, and with but a single seed embedded in yellow pulp. One-third of the seed is rough and the rest smooth, and is not unlike a miniature of a seed of Mimusops heckelii.

PHENOLOGY. The tree has a short deciduous period which begins in February and ends in March. The flowers appear in February just as the tree is beginning to lose its leaves, and they continue into March. The fruits are ripe in March and April. Flowering, fruiting and leafshedding all occupy short periods. Abundand fruits are produced, some of which are eaten by the larger birds, but many fall to the ground where the small animals help in their distribution.

DISTRIBUTION & SILVICULTURE. This species is found in the Moist Semi-Deciduous Forest, particularly in the Celtis-Triplochiton Association. It avoids the northern edge of the High Forest where A. altissima is common, and is almost absent from the southern margin which abuts upon the Rain Forest. A. robusta is a moderate light demander, and will tolerate high, but not too dense shade in youth. It prefers the lighter, well drained sites.

Enumeration figures give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11--
Asenanyo	77	7	1	1	1	-
Afram Headwaters	185	51	7	4	2	1

SEEDLING. Germination is hypogeal. The stem is slender, green, covered with a dense mat of long, silky, red-brown hairs. The first two leaves are simple and opposite, and are borne about 3 in. above ground. The leaf is broadly elliptic, about 1.6 in. long and 1.2 in. broad, acute, broadly cuneate, with a dense, rusty brown indumentum below, and a short petiole. The succeeding leaves are alternate and without stipules. The 3rd. leaf is elliptic, about $2\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. broad, entire, broadly acuminate, cuneate, with a short petiole and with the midrib and nerves very prominent on the underside of the lamina. The stem, petioles and undersides of the midribs and nerves are covered with a dense, rusty brown indumentum of soft hairs.

NATURAL REGENERATION. This is fairly common locally. Where the tree canopy is not too dense, the seedlings progress steadily.

ARTIFICIAL REGENERATION. There are about 20 seeds to one ounce. The germination period is about 17 days. Growth appears to be slow, in the initial stages at any rate.

FIELD NOTES. The significant difference between the two species is the presence of the dense indumentum of rusty brown hairs on the underside of the leaf of A. robusta and the almost glabrous (entirely glabrous after a while) leaf of A. altissima.

2. CHRYSOPHYLLUM L.

The species are not easy to separate botanically. The flowers are small, pentamerous and similar, but there are differences in the fruits and leaves - sometimes marked and at other times not very obvious. The leaves are simple, alternate and exstipulate. The seeds arecharacteristic for the genus, being shiny brown, flattened and with a prominent hilum. The name Sanfena (Ash,T) may be applied generally to this genus and to Aningueria.

SPECIES. (i) C. africanum A.DC. (ii) C. albidum G.Don (iii) C. giganteum A.Chev. (iv) C. glomeruliferum Hutch.& Dalz. (v) C. laurentii De Wild. (vi) C. metallicum Hutch.& Dalz. (vii) C. pentagonocarpum Engl.& Krause (viii) C. perpulchrum Mildbr. (ix) C. pruniforme Engl.

(i) Chrysophyllum africanum A.DC.

VERNACULAR NAMES. Alisima (W). Ananchi (W). Attabini (Ash).

A medium sized tree with a fairly straight bole, and buttressed. The crown is low and spreading. The bark is smooth and the slash is brown , and from it a white latex exudes.

BOTANY. The leaf is oblong-lanceolate, about 7½ in. long and 2¼ in. broad, or larger, entire, acuminate, cuneate and with a petiole about ¾ in. long. The midrib and nerves, which are not looped, are prominently raised below, and the underside of the lamina is covered with a close mat of light brown silky hairs, which when young are red rather than brown. The red coloration in the young leaf tends to cause confusion between this species and C. perpulchrum. The pentamerous flowers are small, about 0.1 in. long, axillary, and are borne on slender pedicels about ¼ in. long. The fruit is almost globose, about 1½ in. diameter, but pointed at the apex, and orange coloured. It contains 5 brown, shiny, flattened seeds.

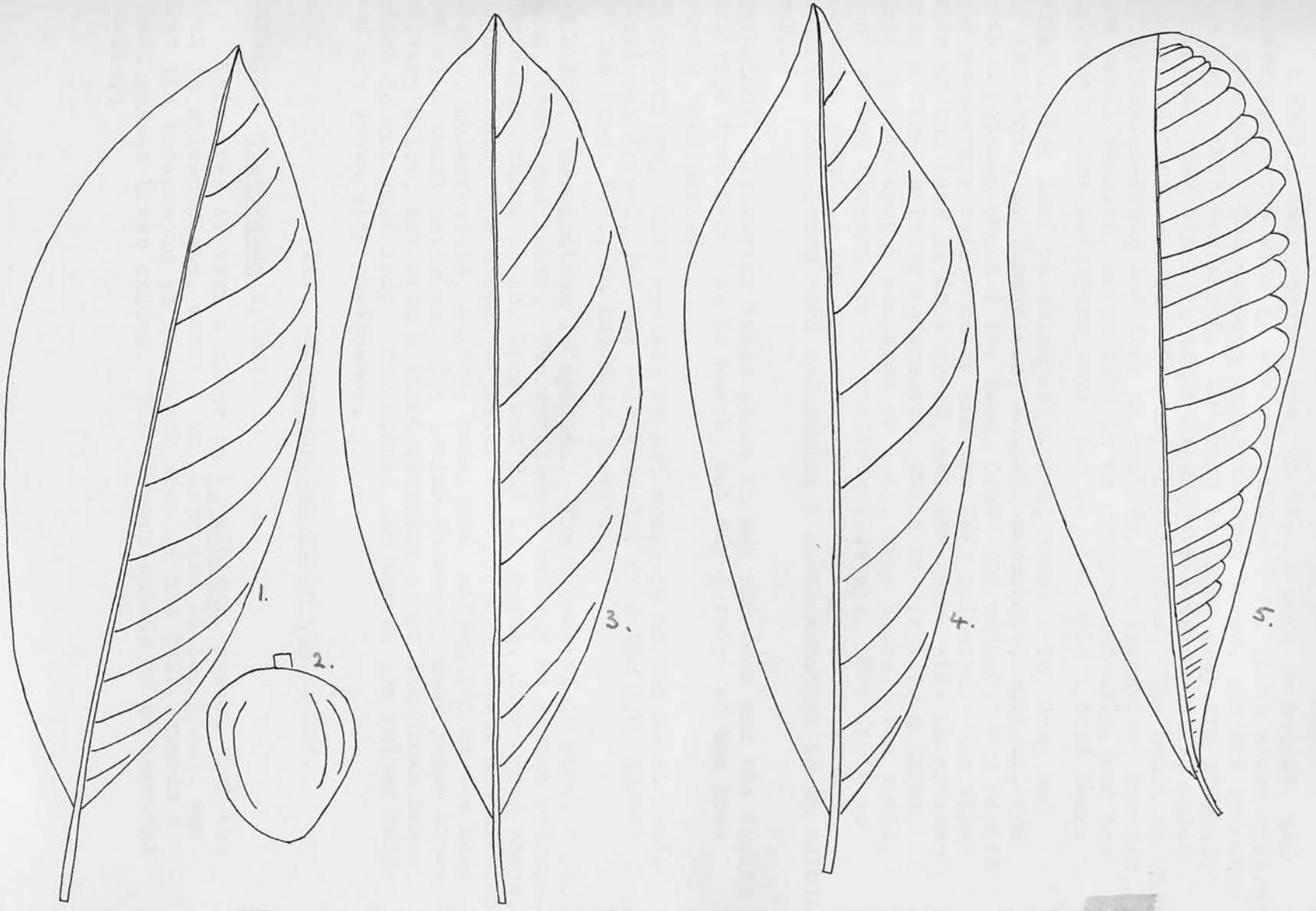
PHENOLOGY. The tree is evergreen and flowers in April and May. The young fruits appear soon afterwards, but are not ripe till August-October.

DISTRIBUTION. This species is often found near streams, but has also been recorded growing on the hillside of Bosumtwi Range, and also on the hills in the Odomi F.R. (Togoland). It is scattered throughout the High Forest Zone.

(ii) Chrysophyllum albidum G.Don

SYNONYMS. C. kayei S.Moore C. millenianum Engl.

VERNACULAR NAMES. Adosa (T). Agya (S). Akasa (Ash). Latcha (Ad).



Chrysophyllum africanum. 1.Leaf. 2.Fruit. C.albidum. 3.Leaf.
C. giganteum. 4.Leaf. C.glomeruliferum. 5.Leaf.

A fairly tall forest tree, 90 ft..or more in height, and buttressed. The stem is slender, about 7 ft. girth above buttresses, and straight. The compact crown is dark green, and the branches are quite thin and short. The bark is light grey and slightly fissured. The slash is light brown, and a white latex, which is not copious, exudes. The sapwood is white. The heart is white to yellowish-brown and fine in texture. In transverse section, the small vessels, which tend to be grouped radially, and the extremely fine medullary rays, can be seen with a hand lens.

BOTANY. The leaf is oblong-elliptic, about 6 in. long and $2\frac{1}{4}$ in. broad, or lanceolate, entire, acuminate, cuneate, and with a petiole about $\frac{1}{2}$ in. long, brown and ridged. The midrib and nerves are raised below and are fawn coloured. The upper side of the leaf is dull green, and the lower side is covered with a fine, silvery indumentum, which at first is a light, dull, golden brown, composed of long, fine hairs. The small, pentamerous flowers are in axillary clusters. The fruit is globose, about $1\frac{1}{2}$ in. diameter, yellow-orange at first but becoming dark brown, and containing 5 seeds embedded in an edible pulp.

PHENOLOGY. Flowering takes place in May and June and the fruits are ripe from December to March, but may persist on the tree beyond this period.

DISTRIBUTION. This species is not uncommon in the Moist Semi-Deciduous Forest, and has been recorded from the S.W. corner of the Subri F.R., in the Rain Forest.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, brown and woody. The cotyledons enlarge to become oblong-orbicular, about $1\frac{1}{2}$ in. long and 0.9 in. broad, dark green above, lighter below and almost sessile. The primary leaves are alternate, simple, oblanceolate, entire, acuminate, attenuated at the base and with short petioles. The lamina is shiny, dark green above, silvery below, but with a light covering of golden brown hairs which do not last long. The midrib and nerves are raised below and are brown with pubescence.

(iii) Chrysophyllum giganteum A.Chev.

SYNONYM. C.obovatum A.Chev.

This tree is very similar to C. albidum, except that the leaf is oblanceolate, about 5 in. long and $1\frac{3}{4}$ in. broad, and that the indumentum on the lower side of the leaf remains a light golden brown colour. The flowers appear to be somewhat smaller.

(iv) Chrysophyllum glomeruliferum Hutch.& Dalz.

SYNONYM. Manilkara dahómeyensis A.Chev.

A tree about 40 ft. high and a girth of 3 ft. The bole is fluted.

BOTANY. The leaf is elongate-obovate, about 5 in. long and 2 in. broad, entire, usually with a rounded apex but sometimes broadly apiculate, cuneate and with a short petiole. The midrib is depressed above and very prominent below, and the nerves are fine and close and almost parallel with one another. At first the leaves are covered with down, but this soon disappears from the upper side leaving it glabrous and pale green, but a silvery-grey close indumentum remains below. Superficially the leaf is not unlike that of Alstonia boonei. The very small axillary flowers are sessile.

PHENOLOGY. Flowers have been recorded in October.

DISTRIBUTION. This species is an understorey tree, and records indicate that it is found in the Antiaris-Chlorophora Association in Ashanti, and on the Atewa Range.

(v) Chrysophyllum laurentii De Wild.

VERNACULAR NAME. Nufunufu (Brong).

The only Gold Coast record known to exist of this species is from near Kintampo (Vigne F.M. 3548), and it is of a tree about 80 ft. high and 7 ft. girth growing in closed forest of the Antiaris-Chlorophora Association.

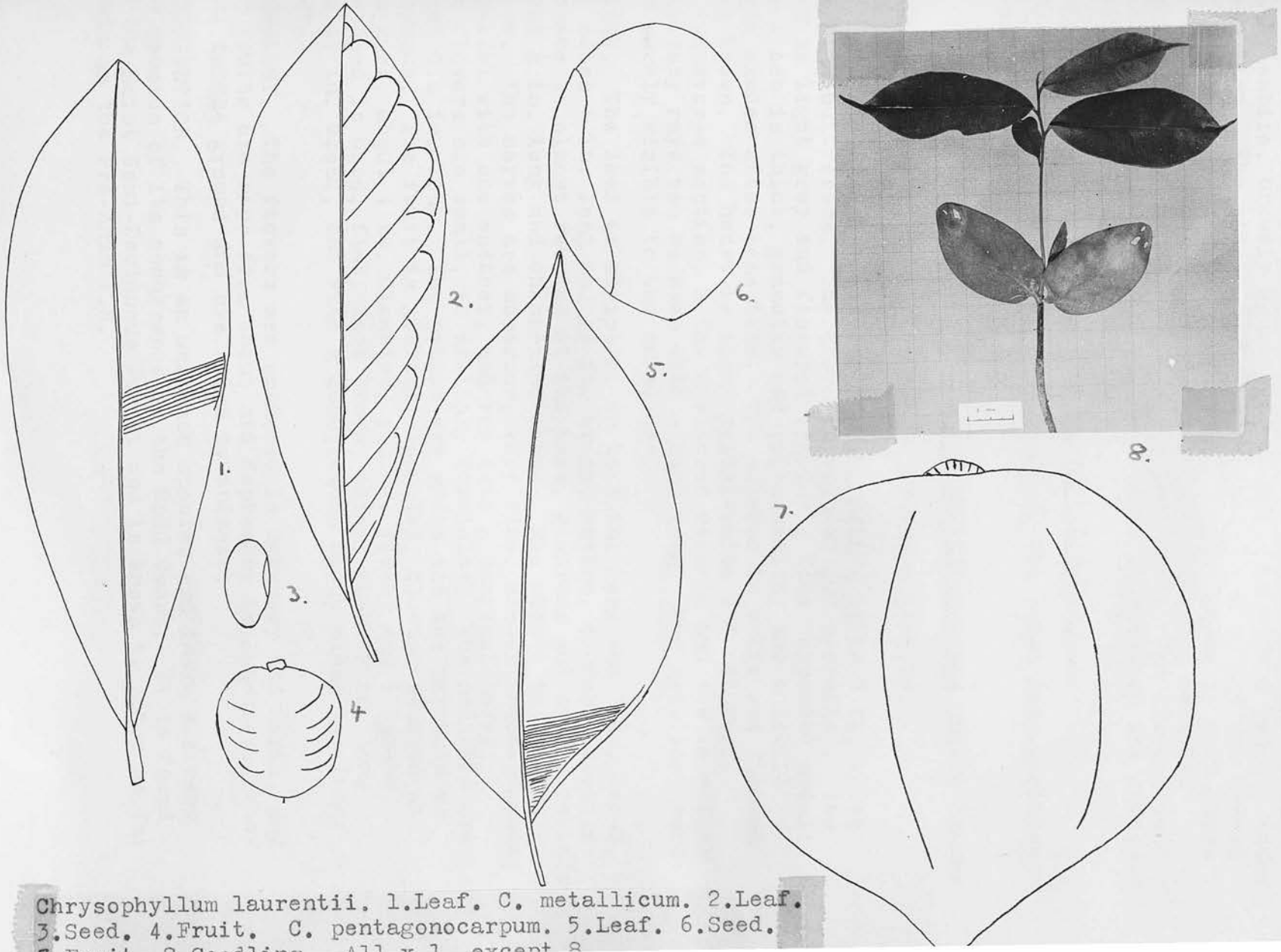
BOTANY. The leaf is elongated obovate, up to 10 in. long and 2½ in. broad, entire, with an apex which is broadly acute or broadly apiculate, and attenuated cuneate at the base. The petiole is variable and may be ½-1 in. long and 0.1 in. broad, woody and ridged. The midrib is depressed above and prominently raised below. The nerves are slightly raised below, fine, very numerous and parallel with one another. The underside of the lamina is covered with a dull, light rusty indumentum. The upper surface is glabrous. The small flowers are bunched on the previous year's wood, and the fine pedicels are nearly ½ in. long.

PHENOLOGY. Flowers have been recorded in January.

(vi) Chrysophyllum metallicum Hutch.& Dalz.

VERNACULAR NAME. Kankabe (Ash).

A tree of about 80 ft. high and 8 ft. girth, but often smaller. The crown is small. The slash is light pinkish-brown and there is a copious milky white latex. The sapwood is white.



Chrysophyllum laurentii. 1.Leaf. C. metallicum. 2.Leaf. 3.Seed. 4.Fruit. C. pentagonocarpum. 5.Leaf. 6.Seed. 7.Fruit. 8.Seedling. All x 1, except 8.

BOTANY. The leaf is oblanceolate, about 4 in. long and 1½ in. broad, entire, broadly acuminate, cuneate and with a petiole about ½ in. long. The midrib is depressed above and it and the nerves are raised below. The upper surface of the lamina is dark green and shiny, and the lower side has a characteristic metallic sheen ranging from silvery to light gun metal. The flowers are small, sessile, and mostly borne in small clusters on the previous year's wood.

PHENOLOGY. Flowers have been recorded in September.

DISTRIBUTION. An uncommon tree found in the Moist Semi-Deciduous Forest.

(vii) Chrysophyllum pentagonocarpum Engl.& Krause

VERNACULAR NAMES. Duatadwe (Ash). Esuindua (Ash,T).

A tall tree, about 130 ft. high, with a girth 9 ft. above the high buttresses. The crown is rounded and spreading. The bark is light grey and fissured regularly like 'expanded metal'. The slash is thick, granular and yellow-white, and a little latex exudes after some time. The sapwood is white and flecked with brown. The heart is light yellow-white and not hard. In transverse section, a few scattered vessels and the very fine medullary rays can be seen with a hand lens. The medullary rays are barely visible to the naked eye.

BOTANY. The leaf is elliptic, up to 7 in..long and 3 in. broad, but often 4 in. long and 1½ in. broad, entire, caudate, broadly cuneate to almost rounded at the base, glabrous and with a petiole about ½ in. long and channelled above. The midrib is raised below. The nerves are numerous, very fine, almost inconspicuous, parallel with one another, and run into a marginal nerve. The flowers are small, in axillary fascicles. The pedicels are about 0.1 in. long. The petals are white and the perianth is caducous. The fruit is globose, 5-angled, blunted pointed at the apex, about 4 in. diameter, yellow, fleshy and 5 seeded. The seed is hard, flat, dark brown, shiny, about 2 in. long and 1½ in. broad, and with a conspicuous hilum along the inner edge.

PHENOLOGY. The flowers are produced in February and March, and the fruits are ripe from about mid September to December. They fall to the ground and are eaten by animals.

DISTRIBUTION. This is an uncommon species and there are very few records of its occurrence in the Gold Coast. It is found in the Moist Semi-Deciduous Forest and is known to occur as far south as the Prà-Anum F.R.

Chrysophyllum perpulchrum. 1.Leaf. 2.Seedling. 3.Seed. 4.Leaves & fruits. C. pruniforme. 5.Seddling. 6.Leaf. All x 1, except 4.

SEEDLING. Germination is epigeal. A long taproot is formed. The hypocotyl is thick, whitish and about 2½ in. long. The cotyledons expand to become foliaceous, elliptic, about 2½ in. long and 1¼ in. broad, fleshy, light gree, 3-nerved from the base and sessile. The first two leaves are opposite and about ½ in. above the cotyledons. The succeeding leaves are alternate. The 4th. leaf is oblong-elliptic, about 4 in. long and 1¾ in. broad, entire, acuminate, cuneate, dull green and with a very short petiole. The midrib is raised above and below, with long, brown hairs set forward and adpressed. The nerves are numerous, fine and almost parallel with one another.

(viii) Chrysophyllum perpulchrum Mildbr.

VERNACULAR NAMES. Agyaa (S). Attabini (Ash,W). Sanfena (T). Sanfena-kokoo (T). The last name means the Red Chrysophyllum - a reference to the red indumentum.

Often a medium sized tree of about 70 ft. high, but sometimes up to 100 ft. The crown is often deep and close to the bole. The light grey bark is slightly fissured. The slash is light brown and granular, and a milky white latex exudes. The sapwood is white.

BOTANY. The leaf is oblong, about 4½ in. long and 1½ in. broad, and bigger, coriaceous, entire, broadly acuminate, cuneate, and with a petiole about 1 in. long. The midrib and nerves are prominently raised below. The veins are just visible to the naked eye and are diagonal to the midrib, and vaguely parallel with one another. The new leaf is covered with a rusty tomentose indumentum which soon comes off, leaving a dark green, shiny, glabrous upper surface, but the lower surface retains the characteristic rusty red close tomentose indumentum. The flowers are small, sessile and in tight axillary fascicles. The fruit is sessile, globose, about 1¼ in. diameter, red-brown and densely tomentellous, vaguely 5 ribbed and containing 5 seed. The seed is about ¾ in. long and ½ in. broad, flattened, shiny dark brown, and with the hilum along almost the whole length of the inner edge.

PHENOLOGY. The tree is evergreen. The flowers are produced in March-April and the fruits are ripe from September to December, but may persist on the tree till April.

DISTRIBUTION & SILVICULTURE. This species belongs to the junction stage of, the upper and lower storeys of the Moist Semi-Deciduous Forest. It is semi-gregarious often and is commonest in the Antiaris-Chlorophora Association, but also occurs in the Celtis-Triplochiton Association. The rusty red leaves are a familiar sight at many places along the Kwahu - Mampong (Ashanti) Scarps, but not in young Secondary Forest. C. perpulchrum is shade tolerant but cannot do with intense shade. It grows slowly and

steadily, and prefers the fairly light, well drained soils.

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, brown, woody and flaky. The shoot is light brown and pubescent. The leaves are alternate and increase in size successively. The 5th. leaf is simple, oblong-lanceolate, about 4 in. long and 1¼ in. broad, entire, acuminate, attenuated cuneate, with a short, pubescent petiole about 0.2 in. long and without stipules. The midrib and few nerves are raised below. The lamina is dark green and glabrous above, light coloured below with a mat of fine hairs, especially on the midrib and nerves.

ARTIFICIAL REGENERATION. There are about 47 seeds to an ounce. The germination period is about 18 days. Stripped plants transplant well. A 12 year old experimental plot in Kumasi contained trees varying from 9 ft. 9 in. to 20 ft. high and 4½ in. to 9½ in. G.B.H.

(ix) Chrysophyllum pruniforme Engl.

SYNONYMS. C. dubardii Pierre C. gracile A.Chev. C. welwitschii A.Chev.

A tree 50-100 ft. high, buttressed at the base, and with a dense crown. The bark is dark and scaly.

BOTANY. The leaf is elliptic, about 4½ in. long and 1¾ in. broad, entire but vaguely undulate, acuminate, cuneate, and with a very short petiole. The midrib is slightly raised above but prominently below. The nerves and veins are fine and raised slightly below. The nerves are few and distinctly looped near to the leaf margin; the veins are numerous and more or less parallel with the nerves. The new leaf is covered at first with a red-brown indumentum which soon disappears, leaving a glabrous leaf. The flowers are in axillary fascicles and are very small, with pedicels less than 0.1 in. long.

PHENOLOGY. Flowers have been observed in February.

DISTRIBUTION. This species has been found in the Rain Forest.

3. MIMUSOPS L.

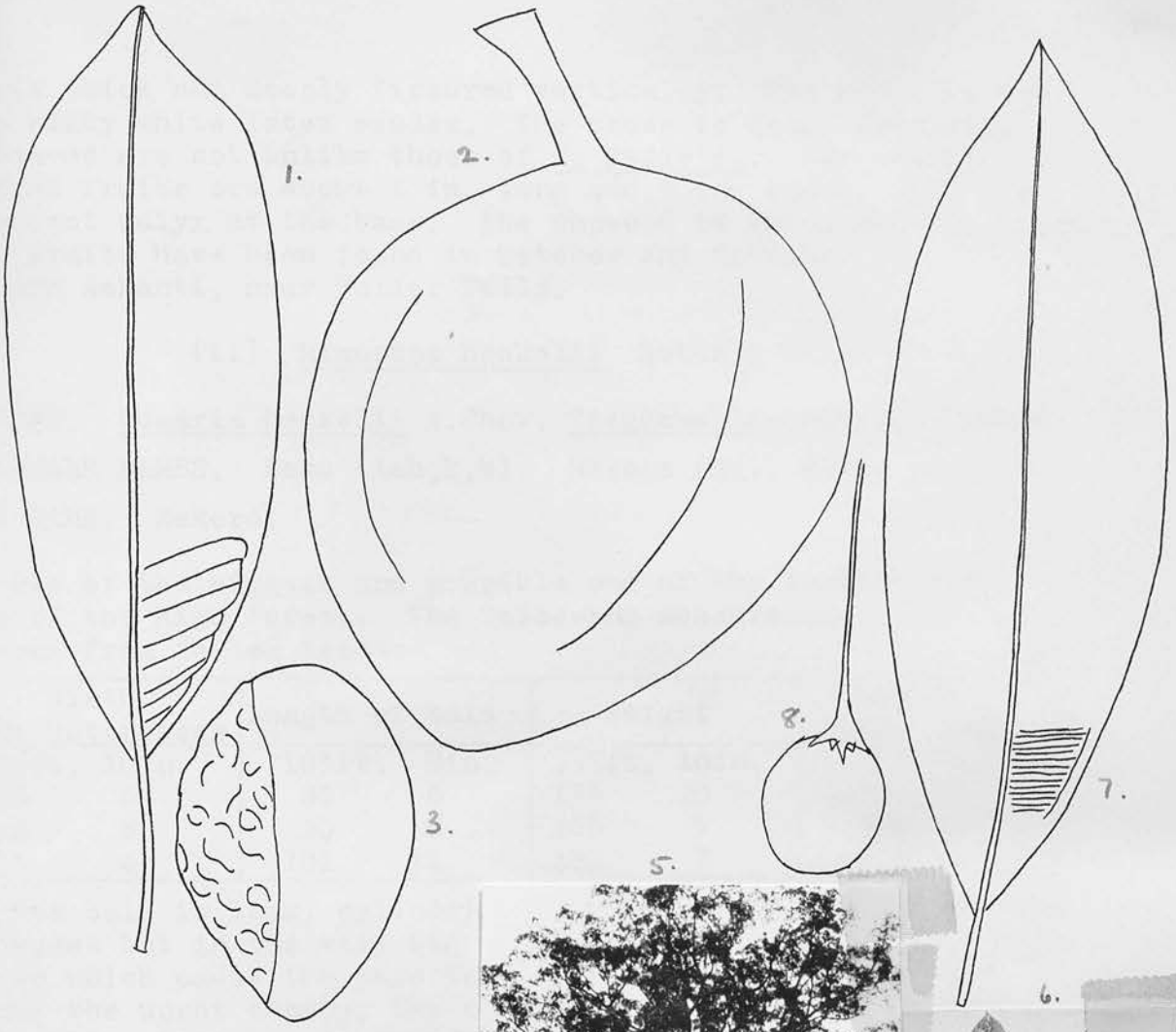
SPECIES. (i) M. fragrans Bak. (ii) M. heckelii Hutch.& Dalz.

(i) Mimusops fragrans Engl.

SYNONYMS. Imbricaria fragrans Bak. M. kerstingii Engl. M. longipes Engl.

VERNACULAR NAME. Berikankum (Ash).

A small tree of the northern edge of the High Forest, particularly of the Riverain Forest in the southern part of the Savannah-Woodland. The bole is without buttresses. The



Mimusops heckelii. 1.Leaf. 2.Fruit. 3.Seed.
All x 1. 4.Bole. 5.Tree. 6.Seedling.
M. fragrans. 7.Leaf. 8.Fruit. Both x 1.

bark is thick and deeply fissured vertically. The slash is red and a milky white latex exudes. The crown is dense and deep. The leaves are not unlike those of M. heckelii. The orange coloured fruits are about 1 in. long and ½ in. broad, with the persistent calyx at the base. The sapwood is white and the heart red. Fruits have been found in October and November in Northern Ashanti, near Fuller Falls.

(ii) Mimusops heckelii Hutch.& Dalz.

SYNONYMS. Dumoria heckelii A.Chev. Tieghemella heckelii Pierre

VERNACUALR NAMES. Baku (Ash,T,W). Makore (Nz). Makwe (Ao).

TRADE NAME. Makore.

One of the biggest and possible one of the longest lived trees of the High Forest. The following measurements were obtained from felled trees:

Girth above buttresses	Length of bole	Height	Volume over bark
16ft. 10in.	105ft. 8in.	177ft. 10in.	1,609 cu. ft.
18 6	86 6	176 10	1,307
20 8	90 6	166 5	1,730
23 4	101 11	183. 7	1,910

The bole is long, cylindrical and clear. There are no true buttresses but in the very big trees, thickened root spurs develop which cause the base to flare a bit. Until the tree reaches the upper canopy, the crown is narrow but may be deep. In the older trees it is rounded, large and spreading and is made up of heavy branches. The bark is grey to almost black, regularly fissured vertically, and particularly deep on the undersides of branches near their base. The slash is thick and red, and a milky white latex exudes from wounds. The sapwood is white. The heart is dark reddish-brown, rather hard and moderately heavy, 38-45 lb. per cu. ft. air dry, with a fine texture, often mottled when cut on the quarter, and durable. The tree is liable to shatter when felled. The wood tends to blunt saws. Pitsawyers complain of suffering from skin irritation when sawing the wood of this tree. With a hand lens, the small vessels can be seen in transverse section, and they tend to form radial groups. The medullary rays are not visible. In longitudinal section, gum can be seen in the small vessels. The handsome wood is used for cabinet work and is sliced fro veneers. It is also used as railway sleepers and underground in mines. Cooking oil is obtained from the seeds (at Domiabra, Juaso Forest District).

BOTANY. The leaves are simple, alternate, exstipulate and crowded towards the ends of the branches. The leaf is oblong-obovate to elliptic-obovate, about 4 in. long and 1¾ in. broad,

entire, with a short broad acumen ot rounded apex, cuneate, glabrous, shiny dark green above and with a narrow petiole about 1¼ in. long. The midrib is raised below, and the nerves are fine, numerous, parallel with one another, and with a white marginal nerve seen when the leaf is held against the light. The flowers are small, scented, yellow, axillary, and on slender pedicels about 1 in. long. There are 8 sepals, 8 petals formed into a corolla tube, and with an equal number of petaloid appendages, 8 epipetalous stamens, and a superior ovary of 8 carpels. The corolla tube with its stamens is caducous. The fruit is a large yellow berry, ovoid, about 3 in. long, obtusely pointed at the apex, with usually i but sometimes 2-3 seed embedded in pulp. The seed is hard, boat shaped, about 2½ in. long, with one side brown, smooth, shiny, and the other rough. The kernel is fatty.

PHENOLOGY. M. heckelii is evergreen. Trees flower at different times from January to May. Although the flowers are quite small and not visible on the large trees, the caducous corolla tubes with their epipetalous stamens are to be seen on the ground under the mother trees. Ripe fruits are to be found from August to March and are produced in reasonable quantities. Because of their size they are conspicuous, especially after falling to the ground. The pulp is eaten by some small animals. Rodents do a great deal of damage by eating the oily cotyledons in the young seedlings. Fruits are seldom produced on trees less than about 7 ft. G.B.H.

DISTRIBUTION & SILVICULTURE. This species is an emergent found throughout the Hig Forest, except along its front with the Savannah-Woodland and the Coastal Scrub and Grassland. None seems to have been recorded from Togoland. It is always scattered and never found in quantity. M. heckelii stands shade very well. In the seedling to pole stages, it will make steady progress in closed forest, and keep on growing straight without any inclination to branch. When overhead light becomes available it will push upwards strongly. It prefers fairly heavy but well drained soils and does not do so well on light soils. Swamps are avoided.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Subri	965	26	13	10	12	6
Fure	381	13	11	11	1	4
Esukawkaw River	1440	13	5	3	11	11
Asenanyo	96	4	1	1	2	5
Bobiri	94	2	2	2	-	2

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, light green and stout. The thick, dark green cotyledons are about 2 in. long and 1 in. broad and do not develop much. They are not foliaceous. The shoot is not as thick as the hypocotyl. The primary leaves are alternate and simple, and the first one is borne about 3½ in. above the cotyledons. The 2nd. leaf is obovate-elliptic, about 4½ in. long and 2 in. broad, entire, acuminate, cuneate, dark green and shiny above. The petiole is about ½ in. long and more or less winged. The midrib is raised below and the nerves are fine, numerous and parallel with one another. The entire seedling is glabrous and exstipulate.

NATURAL REGENERATION. Despite the abundant fruiting, there is very little natural regeneration. As germination is ordinarily good, this lack of regeneration can be ascribed to small animals, particularly rodents, eating the cotyledons as soon as they emerge from the hard seed coat. In the first month, the young seedling grows quickly, and then settles down to slow, steady growth under shady conditions. It takes advantage of overhead light to put on good height increment. This is a most accommodating tree as far as light conditions are concerned.

ARTIFICIAL REGENERATION. There are about 24 seeds to 1 lb. Because of the fatty cotyledons, the seeds do not keep well. The germination period is about 16 days but may be up to 34. Nursery results are more often than not very poor and this is almost entirely due to rodents eating the cotyledons. Where the beds have been fenced to keep out rodents, germination percentages up to 86 have been obtained. Suitably placed traps have also caught some rodents! The sedds should be placed on the surface of the soil and covered only very lightly, if at all. When underneath a fairly hard soil, the hypocotyl is liable to break when trying to carry the heavy cotyledons above ground. In nursery conditions, with at most a light shade from split raphia screens, the growth of the seedling in its first 6 months is about 17-25 in. In a year the height is 2 ft. 8 in. to 3 ft. 1 in. The plant percent at this stage is about 80. At 18 months the heights vary from 3 ft. to 7 ft. With this species it is best to sow the species at 9 in. X 12 in. in rowsn and not to transplant when in the nursery. The plants may be lifted at 12-15 months, but because of their long taproot, they should first be undercut. For plantation work, stripped plants 3 ft. to 5 ft. high give better establishment results than stumped plants, although the latter do quite well. Transplanting should be done under high shade. For the first year in the forest, the stripling makes little progress in height development.

In the 1935 Taungya Plantation in the Pra-Anum F.R., Mimusops was used to underplant Cedrela mexicana. 13 years later they were 5-11 ft. high and very healthy under the mich more vigorous light demanding Cedrela.

FIELD NOTES. At first sight the tree may be mistaken for Terminalia ivorensis because of the dark fissured bole. On the undersides of the big branches, especially near their origins, the fissures are much deeper in Mimusops. But the slashes of the two species are diagnostic. In Mimusops the slash is red and with latex; in T. ivorensis it is yellow and without latex.

4. OMPHALOCARPUM P.Beauv.

SPECIES. (i) O. ahia A.Chev. (ii) O. elatum Miers (iii) O. pachysteloides Mildbr. (iv) O. procerum P.Beauv.

All are medium sized trees, with the exception of O. pachysteloides which is an understorey tree, and with small, tight crowns and cauliflorous flowers and fruits. The flowers are borne on the bole except for those of O. pachysteloides which are on the branches. The flowers are usually unisexual. The leaves are alternate and simple.

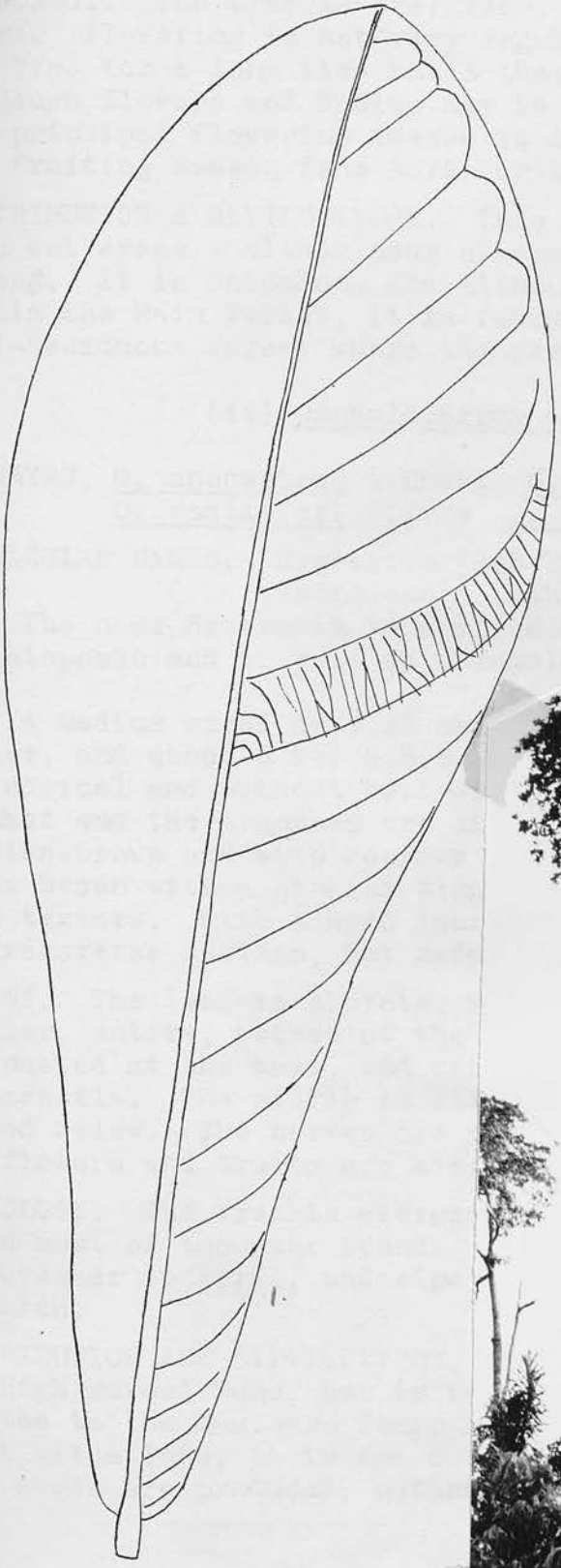
(i) Omphalocarpum ahia A.Chev.

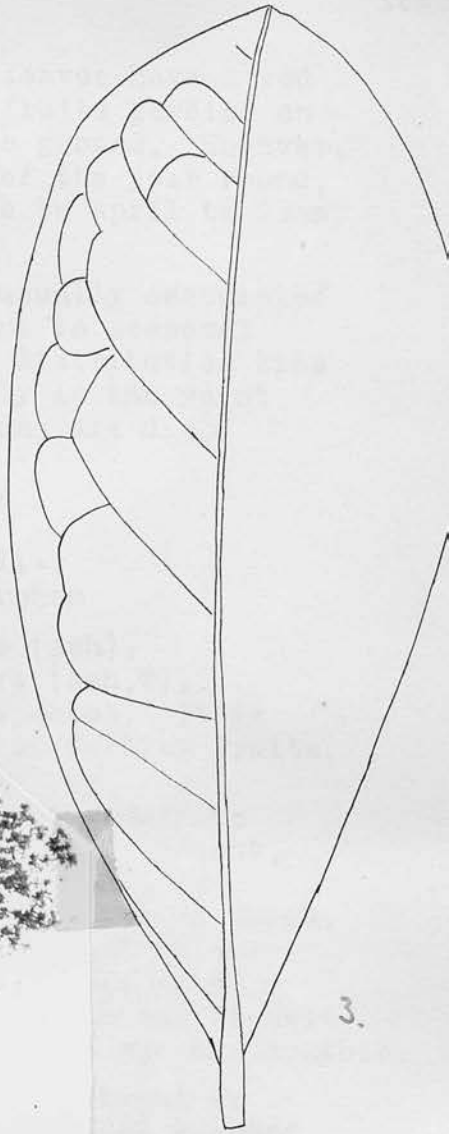
VERNACULAR NAMES. Asoro (Ao,Nz). Brebretim (Ash,T). Duampompo (Ash). Ketibubaka (Ao). Mpradua (Ash). Nsuodua (Ash).

Duampompo means the tree with boils - a reference to the cauliflorous, large, rounded fruits.

A tree of about 80 ft. high or sometimes taller, and about 7 ft. G.B.H. The stem is long, slender, straight and without buttresses. It is often seen bearing large cauliflorous fruits. The crown is small and compact, and the branches are thin and short. The bark is fairly smooth and the slash is red-brown, thick and with copious milky white latex which is slightly sticky. The sapwood is white and the heart pinkish.

BOTANY. The leaf is obovate and large, about 17 in. long and 7 in. broad, entire, obtuse at the apex, attenuated at the base, and with a very short petiole, flattened above and rounded below. The midrib is broad, slightly raised above and prominently raised below. The nerves are raised below, widely spaced and almost at right angles or obtusely set to the midrib. The midrib and nerves are pubescent above and below and there is scattered pubescence on the rest of the lamina. The flowers are borne on the trunk, even near the base, and are usually unisexual, with 5 sepals and 5 petals. The stamen bundles are opposite the corolla lobes. In the female flowers the stamens are sterile. The superior ovary is multilocular. The cauliflorous fruits are large, depressed globose, about 5 in. diameter, hard, dull light brown, with about 10-30 seeds in a dark coloured pulp. The seed is up to 2 in. long, smooth, flat and with a conspicuous hilum on the inner edge.





Omphalocarpum ahia. 1.Leaf x ½. 2.Tree.
O. elatum. 3.Leaf x 1.

PHENOLOGY. The tree is evergreen. The young leaves have a red flush. Flowering is not very regular and the fruits persist on the tree for a long time until they fall to the ground. However, although flowers and fruits may be found most of the year round, the principal flowering season is considered to be April to June, and fruiting season from November to February.

DISTRIBUTION & SILVICULTURE. This species is usually associated with wet areas - either near streams or adjacent to seasonal swamps. It is uncommon, and although its main distribution lies within the Rain Forest, it is found occasionally in the Moist Semi-Deciduous Forest where the ground conditions are damp.

(ii) Omphalocarpum elatum Miers

SYNONYMS. O. anocentrum A.Chev. O. procerum Oliv.
O. radlkoferi Pierre O. talbotii Wernham

VERNACULAR NAMES. Brebretim (Ash,T). Duampompo (Ash).
Esonodokono (Ash). Timatebere (Ash,T).

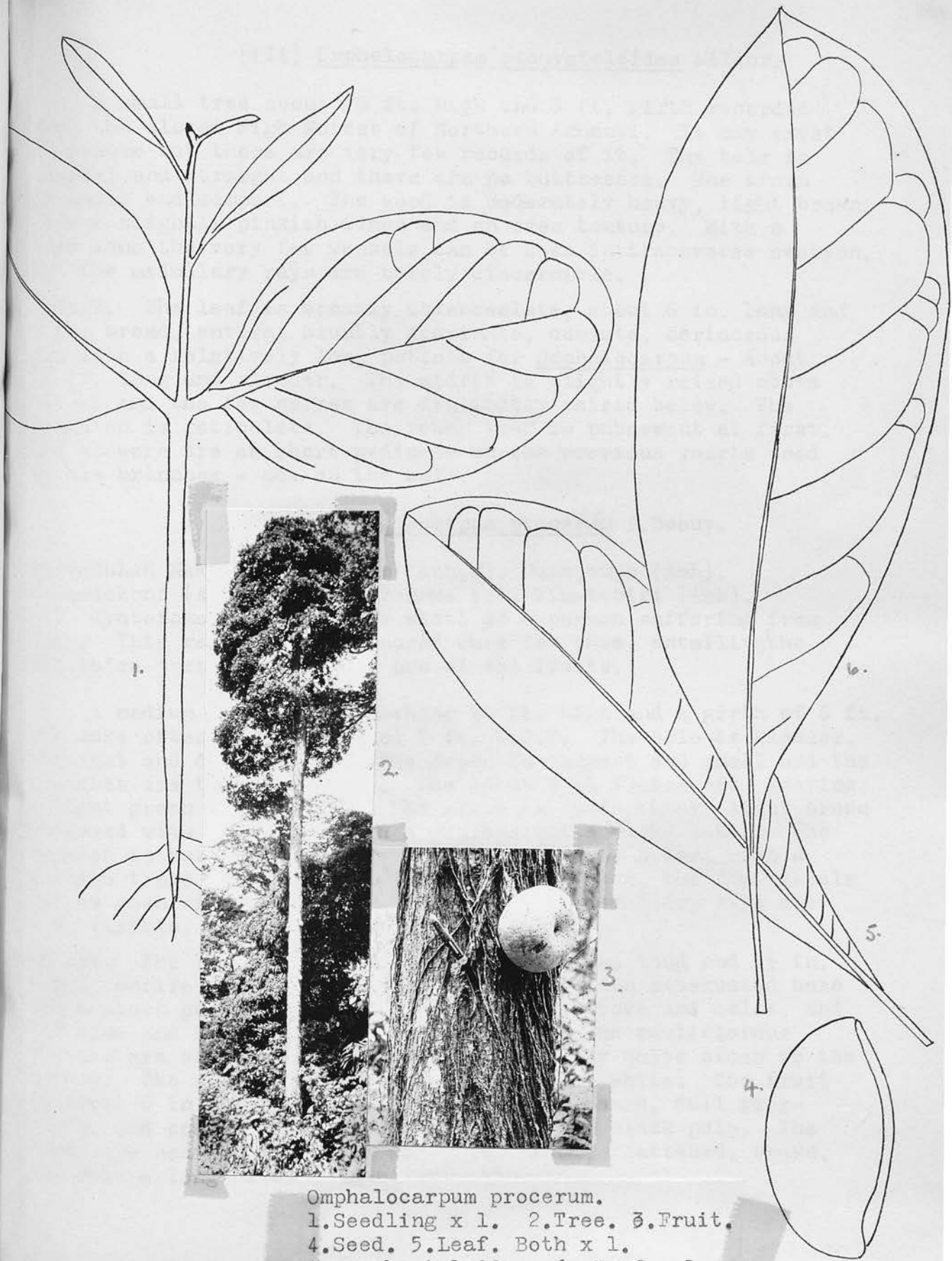
The name Brebretim is applied to all the species. It is onomatopoeic and is said to resemble the sound of falling fruits.

A medium sized tree of about 70 ft. high, but sometimes taller, and about 6 ft. G.B.H. The bole is slender, straight, cylindrical and without buttresses. The crown is small and compact and the branches are short and thin. The slash is thick, reddish-brown and with copious milky latex. The heart is very light brown with a pinkish tinge, moderately heavy and of an even texture. With a hand lens, the very few vessels can be seen in transverse section, but medullary rays are almost not discernible.

BOTANY. The leaf is obovate, 9 in. long and 2½ in. broad or smaller, entire, obtuse at the apex or sometimes almost rounded, attenuated at the base, and with a very short petiole - almost sub-sessile. The midrib is slightly raised above and prominently raised below. The nerves are raised below and are set wide apart. The flowers and fruits are similar to those of O. ahia.

PHENOLOGY. The tree is evergreen. Flowers and fruits may be found most of the year round. The principal flowering season is November to April, and ripe fruits are available from August to March.

DISTRIBUTION AND SILVICULTURE. This species is found throughout the High Forest Zone, but is rare. It has been recorded from Prestea to the Southern Scarp F.R. Although preferring fairly moist situations, it is not confined to them. Even although many seeds are produced, natural regeneration is seldom seen.



Omphalocarpum procerum.
1.Seedling x 1. 2.Tree. 3.Fruit.
4.Seed. 5.Leaf. Both x 1.
O. pachysteloides. 6. Leaf x 1.

(iii) Omphalocarpum pachysteloides Mildbr.

A small tree about 20 ft. high and 3 ft. girth recorded from the closed High Forest of Northern Ashanti. It may exist elsewhere but there are very few records of it. The bole is slender and straight and there are no buttresses. The crown is small and compact. The wood is moderately heavy, light brown with a slightly pinkish tinge and an even texture. With a hand lens the very few vessels can be seen in transverse section, but the medullary rays are barely discernible.

BOTANY. The leaf is broadly oblanceolate, about 8 in. long and 3 in. broad, entire, bluntly acuminate, cuneate, coriaceous and with a relatively long petiole for Omphalocarpum - about 1½ in. long and slender. The midrib is slightly raised above but it and the few nerves are distinctly raised below. The venation is reticulate. The young leaf is pubescent at first. The flowers are on short pedicels on the previous year's wood on the branches - not on the bole.

(iv) Omphalocarpum procerum P.Beauv.

VERNACULAR NAMES. Brebretim (Ash,T). Duampompo (Ash). Esonodokono (Ash). Gyatofokonnua (T). Timatebiri (Ash).

Gyatofokonnua means the stool of a person suffering from yaws. This refers to a supposed cure for yaws, entailing the afflicted person sitting on one of the fruits.

A medium sized tree reaching 90 ft. high and a girth of 6 ft. but more often 60-70 high and 5 ft. G.B.H. The bole is slender, straight and cylindrical. The crown is compact and small and the branches are thin and short. The outer bark flakes off leaving a light green under layer. The slash is quite thick, light brown suffused with pink, and with a copious white milky latex. The sapwood is hard and white. The heart is light brown, with a pinkish tinge, and hard. In transverse section, the few vessels can be seen with a hand lens, and the fine medullary rays are just visible.

BOTANY. The leaf is oblanceolate, about 5 in. long and 1½ in. broad, entire, with a broadly acuminate tip, an attenuated base and a short petiole. The midrib is raised above and below, and the fine and few nerves are raised below. The cauliflorous flowers are borne on the bole, and may appear quite close to the ground. The sepals are brown and the petals white. The fruit is about 6 in. diameter, depressed globose, hard, dull grey-brown, and containing 15 seeds embedded in a black pulp. The seeds are nearly 2 in. long and 1 in. broad, flattened, brown, and with a long hilum on the inner edge.

PHENOLOGY. The tree is evergreen. Flowers and fruits are to be seen during most of the year. The main flowering period is February to July, and fruiting from July to March. The fruits may persist on the tree for a long time before they drop off. The fruits disentegrate on the ground.

DISTRIBUTION & SILVICULTURE. So far, the only records of this species are from the Celtis-Triplochiton Association. It is very infrequent, and although not confined to moist situations, it prefers them, but not swampy conditions. It will grow in Secondary Forest.

SEEDLING. Germination is epigeal. The stout, red, woody hypocotyl is about 3½ in. long and with fine, vertical ridges. The cotyledons expand to become foliaceous, elliptic, about 3 in. long and 2 in. broad, with petioles about 0.3 in. long, flattened above and below. The upper sides of the cotyledons are dull green and lighter on the lower sides. The primary leaves are alternate, and the first is borne about 1¼ in. above the cotyledons. The leaf is oblong-lanceolate. The shoot is green and it and the leaves are covered with a few short, red-brown hairs.

ARTIFICIAL REGENERATION. There are about 73 seeds to 1 lb. The germination period is about 15 days and the germination percent about 79.

SCYTOPETALACEAE.

There is only one genus in this West African family, and only one species is represented in the Gold Coast.

SCYTOPETALUM Pierre

Scytopetalum tieghemii Hutch.& Dalz.

SYNONYM. Rhaptopetalum tieghemii A.Chev.

VERNACULAR NAMES. Amene (Nz). Eprim (Nz). Penim (W). Sumili (Nz).

A small to medium sized tree, not often much more than 60 ft. high and 6 ft. G.B.H. The bole is slender, straight, cylindrical and without buttresses. The crown is deep and spreading, but the foliage is not very dense. There are many thin branches; epicormic buds develop into slender branches almost parallel with the bole and below the main crown. The bark is grey, with thin scales. The slash is thick and fibrous, has a red tinge in the thin outer layer, and then dull very light brown below. The sapwood is light brown and hard. The heart is grey-brown, hard and heavy, about 48 lb. per cu. ft. at 12% moisture content, woolly and difficult to work. It is not resistant to decay. In transverse section, the many small vessels can be seen, but the numerous medullary rays are barely visible. With a hand lens many fine parenchyma bands are to be seen between the medullary rays.

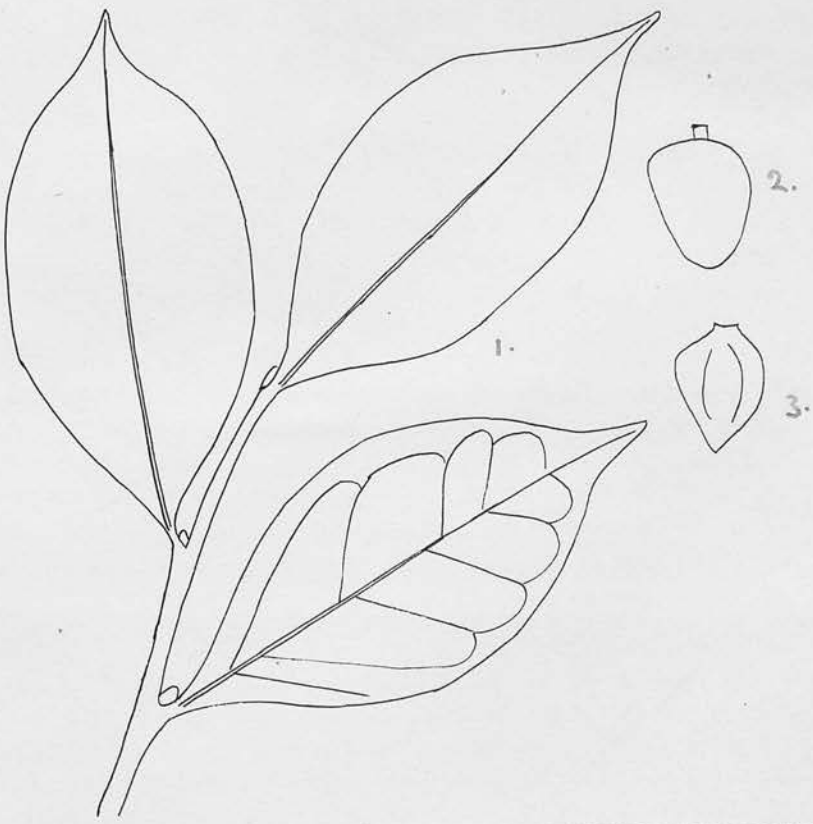
BOTANY. The leaves are simple and alternate. The leaf is narrowly elliptic, about 3 in. long and 1½ in. broad, entire but with the margin turned over slightly, with a long acumen, cuneate, dark green, and with a very short petiole. The midrib is slightly raised above and below. The nerves are few, inconspicuous, and looped well within the margin. The small white flowers are scented. The calyx is cupular. There are usually 7 petals, many stamens and a 6-locular superior ovary. The fruit is a 1-seeded drupe, obtusely pointed at the apex, about ¾ in. long and ½ in. broad. It ripens from red to a plum colour. The seed is slightly ribbed longitudinally and pointed.

PHENOLOGY. The tree is evergreen. Flowering takes place from mid March to mid May. Ripe fruits are available in July and August. They do not appear to be particularly attractive to birds. The fruits are produced in quantity and fall to the ground under the mother trees. By September most of the seeds are rotten and scarcely any natural regeneration can be seen.

DISTRIBUTION & SILVICULTURE. Scytopetalum is found in the Rain Forest and in the Lophira-Triplochiton Association of the Moist Semi-Deciduous Forest. It is a tree of the lower storey, shade tolerant and usually common where it occurs.

The following frequencies are from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Ankasa River	120	306	40	2	-
Cape Three Points	129	33	25	12	6
Bonsa River	73	148	7	-	-
Kakum	150	18	6	2	-



Scytopetalum tieghemii. 1.Leaves. 2.Fruit. 3.Seed. All x 1.

SIMAROUBACEAE.

This family contains trees and shrubs with alternate leaves which are either simple or compound. When stipules are present they are long and enclose the bud. The flowers are small, usually hermaphrodite but also unisexual. There are 3-5 sepals, 5 petals, 10 stamens and a superior ovary of often 5 united carpels. The fruit is a drupe.

GENERA. 1. Balanites Del. 2. Hannoa Planch. 3. Irvingia Hk.f. 4. Klainedoxa Pierre

1. BALANITES Del.

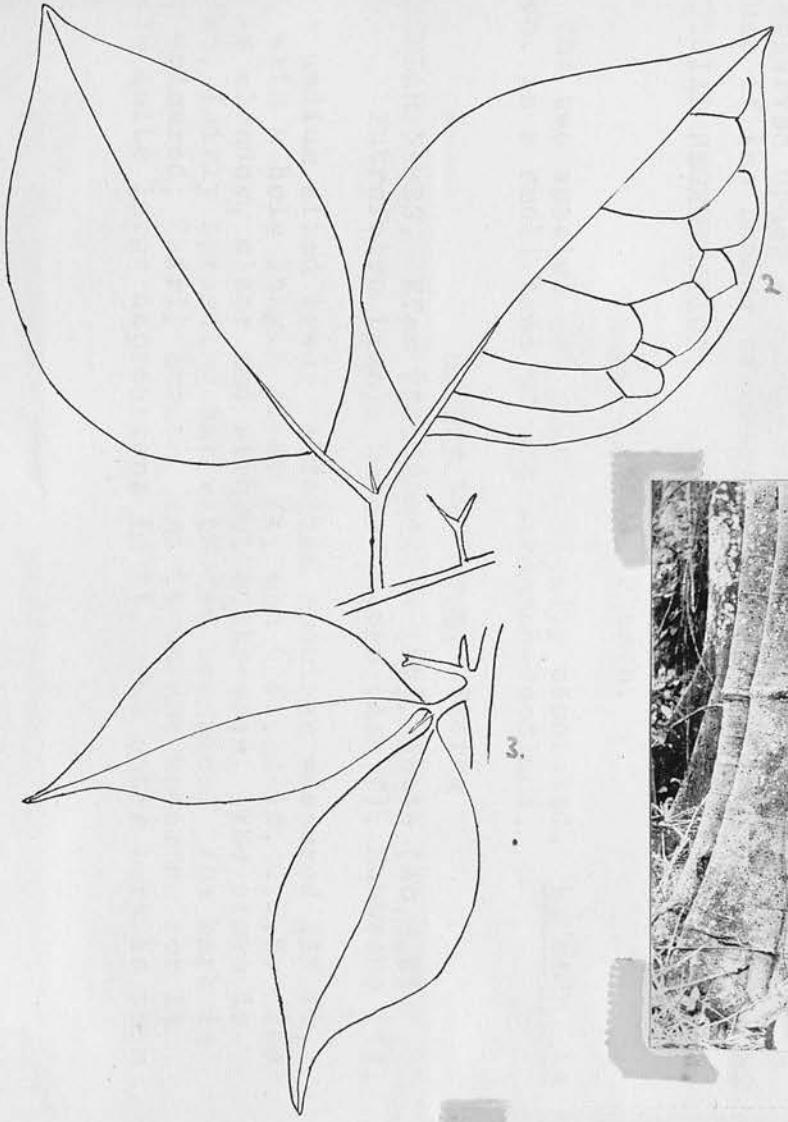
B. aegyptiaca Del. is a small tree of the Savannah-Woodland, with long twin green spines and an edible fruit.

Balanites wilsoniana Dawe & Sprague

VERNACULAR NAMES. Krobo (S,W). Krobodua (Ash,F,T). Waka (Ash). Krobo is the name of the gum obtained from the tree, and dua means a tree.

Often a tree of about 90 ft. high, but one growing on the Ashanti Mampong Scarp was estimated being 120 ft. high and 9 ft. girth (Vigne F.H. 1059). The bole is badly fluted for its entire length and it must be one of the worst of its kind for a tree of its size - certainly in the Gold Coast forest. The crown is small. The bark is grey and smooth. The slash is thin, white to light brown, with a slightly grey appearance under the bark, and semi-granular. Large vessels are visible in the white wood white tends to assume a yellow tinge on exposure. The wood is white and fairly heavy. In transverse section the vessels are seen to be very scattered. The medullary rays are numerous and very distinct. The gum which exudes in time from wounds is made into a scented ointment and smeared on newborn babies.

BOTANY. The leaves are alternate, compound and stipulate, and consist of a pair of opposite leaflets. The leaflet is ovate-elliptic, about 3 in. long and 2 in. broad, entire, acuminate, cuneate to almost rounded at the base, glabrous except for a few white hairs on theunderside of the midrib and rhachis. The petiolules and rhachis are very short on young plants but about 0.4 in. and 0.7 in. long, respectively, on mature trees. They are markedly channelled above. The midrib is raised below, but the nerves are rather inconspicuous. The bifurcated spines are supra-axillary; the common axis is about 0.15 in. long and each arm about 0.4 in. long; one arm may itself bifurcate. There is a small, linear stipella with each pair of leaflets, situated



Balanites wilsoniana. 1.Seedling. 2.Leaf.x 1.
3. Juvenile leaf x 1. 4.Bole.

at the apex of the rhachis. The flowering branches are without the bifurcated spines, but in their places are the small flowers. The flower is pentamerous, with twice the number of stamens. The fruit is a yellow, ellipsoid drupe, about 3 in. long and 1½ in. broad, with a somewhat fibrous, pulpy mesocarp, and a thick, hard, woody endocarp, containing one large oily seed.

PHENOLOGY. Balanites is evergreen. Flowering takes place from December to March, and the ripe fruits are available in April and May. They fall to the ground under the mother tree, and after germination, the oily cotyledons are liable to be eaten by rodents.

DISTRIBUTION. This species is rare. It belongs to the Moist Semi-Deciduous Forest, particularly to the Antiaris-Chlorophora Association - Pamu-Berekum, Abrimasu and Boumfum F.Rs. and Ashanti Mampong Scarp. It has also been seen in the Pra-Anum and Asenanyo F.Rs. in the Celtis-Triplochiton Association. There is an unconfirmed report of a specimen in the Fure F.R.

SEEDLING. Germination is hypogeal. The hard endocarp splits into five parts, but the cotyledons do not emerge. The shoot is green and stout and is covered with very short white hairs which soon disappear. The leaves are alternate and compound, and consist of a pair of opposite leaflets. The leaflet is lanceolate, about 1 in. long and 0.3 in. broad on the 4th. pair. The triangular stipules are very short. The bifurcated spines are supra-axillary, but in very young specimens may appear to be axillary.

NATURAL REGENERATION. A good quantity of natural regeneration was observed under a mother tree in June. But little survived because of the number of cotyledons that were eaten by rodents.

ARTIFICIAL REGENERATION. There are about 8 dry fruits to 1 lb.

2. HANNOA Planch.

The two species are geographically separated. H. undulata Planch. is a small tree of the Savannah-Woodland.

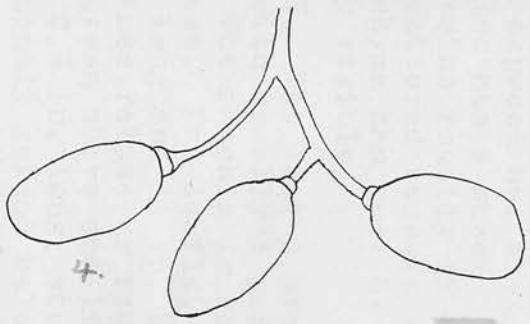
Hannoa klaineana Pierre

VERNACULAR NAMES. Efan (S). Evoidire (Nz). Fotie (Ao,S.W). Futrofutro (Ash). Hotorohotoro (Ash,T). Huhuroho (T).

A medium sized tree. A felled specimen measured 115 ft. high, with a bole length of 80 ft. and 6 ft. 1 in. G.B.H. The bole is slender, clear and without buttresses. The crown is rounded, fairly spreading but with few branches. The bark is light coloured, fairly smooth, and it is not uncommon for it to have quite large depressions in it. The outer bark is thin

1.

2.



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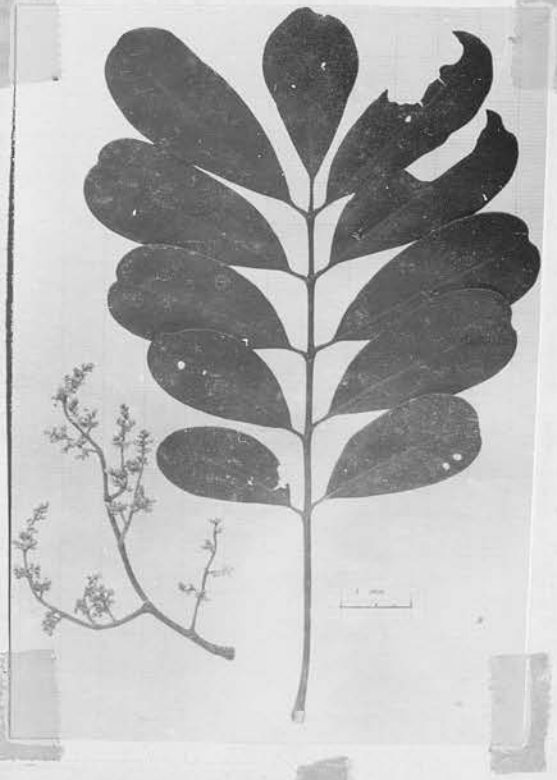


3.

Hannoa klaineana. 1.Tree. 2.Bole. 3.Leaf & flowers.
4.Fruits x 1.

and brittle and comes away easily when a couple of nicks are made close together with a knife. The slash is white and the white sapwood has a sheen. The heart is white, light and soft, and also has a sheen. It is easy to work but is not durable and stains readily if not dried quickly. In transverse section the scattered vessels are visible and the very narrow banded parenchyma can just be seen. The medullary rays are fine and barely visible.

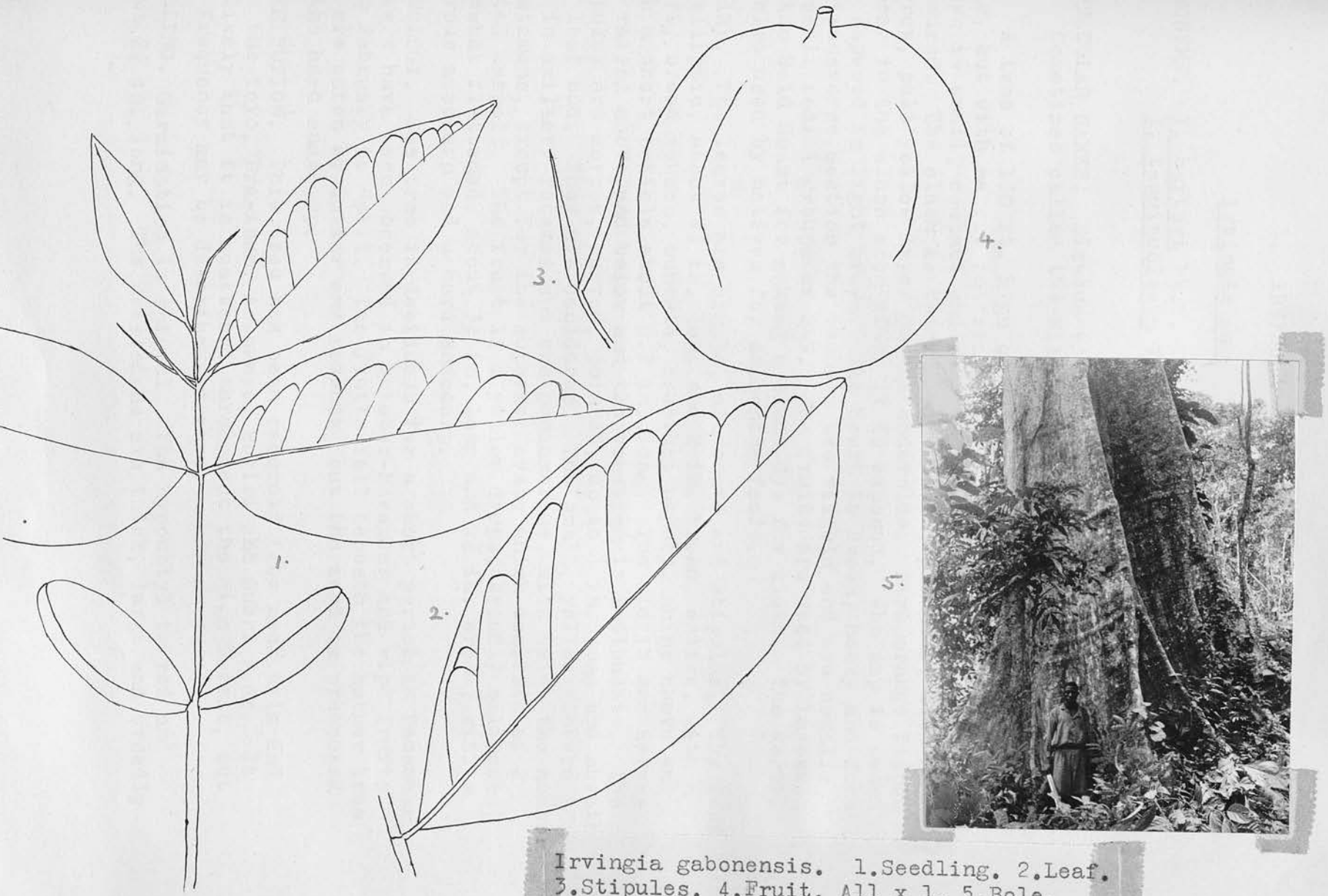
BOTANY. The leaves are alternate, imparipinnate, about 8 in. long with usually 5 pairs of opposite leaflets and a terminal one. The rhachis is somewhat flattened on the upper side towards the base. The leaflet is oblong to broadly oblanceolate, about 3 in. long and 1½ in. broad, entire, usually apiculate but sometimes retuse or rounded, cuneate, stiff, glabrous, glossy dark green above and lighter green below. The petiolule is about 0.3 in. long, stout and flattened above. The midrib is prominently raised below and appears yellow-green above. The nerves are not very conspicuous except for a yellow marginal nerve. The small, white, scented, ~~unisexual~~ flowers are in lax terminal panicles and are male and hermaphrodite. The male consists of 3 sepals, 5 petals and 10 stamens. The hermaphrodite flower is similar with the addition of a 5-locular, superior ovary. The fruit is an oblong drupe, about 0.8 in. long and ½ in. broad, becoming black and containing 1 seed.

PHENOLOGY. There is a short deciduous period in November-December, but this may not be perceptible as flushing occurs soon afterwards. The flowers are produced from August to November, and the white panicles cover the crown of the tree. The perianth and stamens are caducous.

DISTRIBUTION & SILVICULTURE. The tree is found throughout the High Forest. It is a light demander and grows quickly - the sapling is capable of putting on a height increment of 2 ft. 6 in. a year. Full overhead light is not required, and the young plant will survive under partial shade. Hannoa is a common tree of the Secondary Forest and its occurrence in closed forest is usually associated with former gaps. It does not seem to have any particular soil preferences except the avoidance of swamps.

ARTIFICIAL REGENERATION. There are about 24 seeds to 1 ounce.

FIELD NOTES. This species is sometimes mistaken in the pole stage for Entandrophragma. Although the latter has red slash this is not usually developed in the young plant. In Hannoa the shoot is dull, dark green, and the leaf scars are very large and white. Also, the petiolules and the rhachis base are flattened above and the latter has particularly sharp edges. These are sufficient characters to separate H. klaineana from the Entandrophragmas.



Irvingia gabonensis. 1.Seedling. 2.Leaf.
3.Stipules. 4.Fruit. All x 1. 5.Bole.

3. IRVINGIA Hk.f.

Irvingia gabonensis Baill.

SYNONYMS. I. barteri Hk.f. I. fusca Van Tiegh I. tenuifolia Hk.f. I. tenuinucleata Van Tiegh Mangifera gabonensis Aubry-Lecomte.

VERNACULAR NAMES. Bisebuo (Ash,Nz,T,W).
Sometimes called the Wild Mango on account of the fruit.

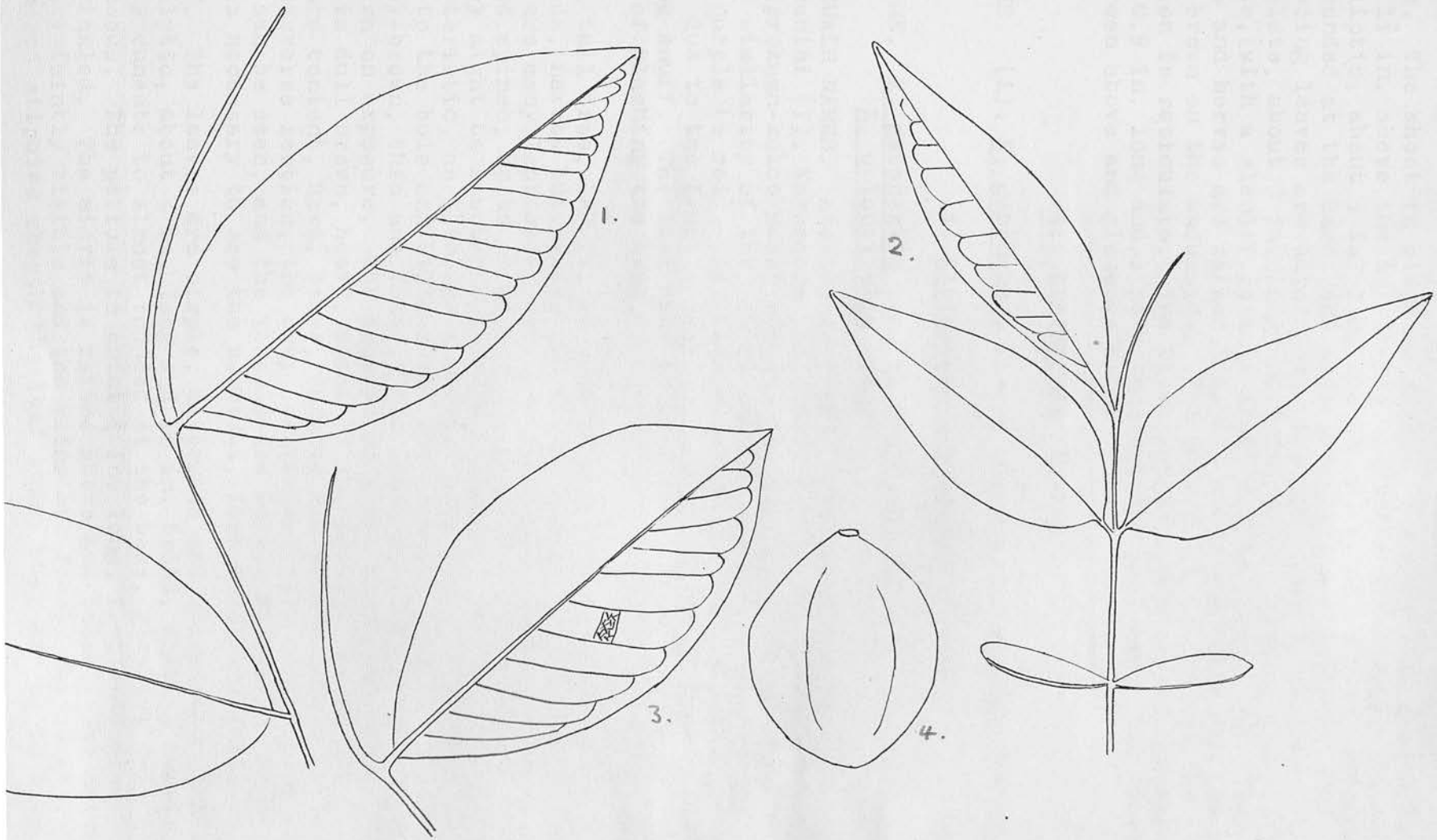
A tree of 130 ft. high or more, with a straight, slender bole, but with narrow buttresses, cometimes 20 ft. high. The crown is small, compact and rounded. The bark is grey and fissured. The slash is thick, light brown, granular, with a narrow, pale yellow layer on the underside. Dark orange flecks appear in the slash soon after it is exposed. The sap is sweet. The sapwood is light brown. The heart is brown, heavy and durable. In transverse section the vessels are visible and are usually in small radial groups of 2-3. The fruits are used by Lagosians in the Gold Coast for making a black dye for cloth. The kernel is also used by natives for seasoning foods.

BOTANY. The leaves are simple, alternate and stipular. The leaf is elliptic, about 4½ in. long and 2 in. broad, entire, with a short, broad acumen, cuneate, somewhat papery, shiny above and with a short petiole about 0.2 in. long. The midrib and nerves are raised above and below and the venation is reticulate. The stipules are narrow, curved, pointed, up to 1 in. long and sheath the leaf bud. They are deciduous. The small, yellow flowers are in axillary racemes and are pentamerous, with twice the number of stamens, except for the superior ovary which consists of 2 united carpels. The fruit is a yellow drupe, broadly ellipsoid, somewhat flattened, about 3½ in. long and 2½ in. broad, with a fibrous mesocarp and a hard endocarp.

PHENOLOGY. The tree is deciduous for a short period in December. Flowers have been observed in October-November and ripe fruits from February to April. The fruits fall beneath the mother tree and are eaten by duiker and rodents, but the seed is protected by the hard endocarp.

DISTRIBUTION. This tree has been recorded from near Axim and from the Yoyo, Pra-Anum, Asenanyo, Bobiri and Subri F.Rs. It is likely that it is scattered throughout the High Forest, but its frequency may be described as rare.

SEEDLING. Germination is epigeal. The hypocotyl is red and about 2½ in. long. The cotyledons are thick, large and broadly



Klainedoxa gabonensis. 1.Leaf. 2.Seedling.
K. gracillima. 3.Leaf. 4.Fruit. All x 1.

oblong. The shoot is glaucous green. The first two leaves are about 1¾ in. above the cotyledons, opposite and simple. The leaf is elliptic, about 3 in. long and 1½ in. broad, entire, acuminate and rounded at the base, and with a fine, short petiole. The succeeding leaves are alternate. The 3rd. leaf is oblong-lanceolate, about 3 in. long and 1 in. broad, entire, acuminate, cuneate, with a slender petiole about 0.15in. long. The fine midrib and nerves are raised slightly above and below and are light brown on the underside. The nerves are looped and the venation is reticulate. The brown stipules are narrow, pointed, about 0.9 in. long and a pair sheathes the leaf bud. The leaves are green above and glaucous below.

4. KLAINEDOXA Pierre

SPECIES. (i). K. gabonensis Pierre (ii) K. gracillima Mildbr.

(i) Klainedoxa gabonensis Pierre

SYNONYMS. K. gabonensis var. oblongifolia Engl.
K. oblongifolia Stapf

VERNACUALR NAMES. Akoankyere (Ash). Aprokuma-kokoo (Ash). Asratoanini (T). Kokoroboa (D). Kroma (Ash,Nz,T,W). Twetwerede (T).

Aprokuma-kokoo means the red Antrocaryon, and this is due to the similarity of the fruits and the flowers of Klainedoxa being purple (= red). Asratoanini means the male snuff calabash, and is due to the fruit resembling a small calabash used for keeping snuff. The last name is said to be onomatopoeic for the sound of slashing the tree.

A tall tree, 140 ft. or more high, with a slender bole and wide, narrow buttresses and often fluted. On the young stem there are many lenticels, and also scattered, hard, narrow, pointed spines, up to about 3 in. long. They appear appear as if they might be stunted epicormic branches. The crown is rather characteristic, as although sometimes spreading, it is usually close to the bole and billows out like cumulus clouds. The bark is grey-brown, thin and flaky. The slash is hard, white, turning purplish on exposure. The sapwood is light brown and hard, The heart is dull brown, heavy, about 71 lb. per cu. ft. at 12% moisture content, hard, dense, durable and with a coarse texture. In transverse section, the wavy, continuous very narrow parenchyma bands can be seen, and the vessels are barely visible; a hand lens is necessary to see the numerous, fine medullary rays.

BOTANY. The leaves are simple, alternate and stipulate. The leaf is elliptic, about 4 in. long and 1¾ in. broad, entire, acuminate, broadly cuneate to almost rounded at the base, glabrous and coriaceous. The petiole is about ¼ in. long, flattened above and wrinkled. The midrib is raised above and below. The nerves are very faintly visible and the veins are finely reticulate. The long paired stipules sheath the leaf buds; they are up to 4 in.

1.

2.

3.

Klainedoxa gabonensis.
1.Tree. 2.Bole. 3.Fruit.

long, linear, curved, pointed and caducous. In theyyoung plant the leaves may be broadly lanceolate, up to 11 in. long and 5 in. broad, and the stipules 6 in. long.
The small mauve to purple flowers are borne in profuse panicles on the crown of the tree. The flower is pentamerous with twice the number of stamens. The fruit is a purplish-black, hard, depressed globose drupe, about 3 in. diameter, and $1\frac{3}{4}$ in. long, with 5 rounded angles. There are 5 almost flattened seeds, sitting vertically, with the narrow edge to the centre. Between the seeds is a short, fibrous mat containing a gummy substance.

PHENOLOGY. The tree is evergreen. Flowering occurs from August to December, when the crown of the tree is conspicuously covered with the mauve flowers. Ripe fruits are obtainable from April to August. They may persist entire on the forestfloor for some time after falling.

DISTRIBUTION & SILVICULTURE. K. gabonensis is apread throughout the High Forest Zone, but it has its greatest frequency in the Rain Forest. There it may be locally common, e.g. near the railway line north of Benso. It is a light demander, but does not require full overhead light for its development. Often it is associated with damp situations, but not where the drainage is impeded. It occurs in Secondary Forest, but usually as quite big trees. It seems possible that these are relics of the former forest crop left by the farmers because of the difficulty of cutting the hard wood of this tree.

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in., longslender, woody, purplish-brown at first, but becoming lighter. The cotyledons are about 0.9 in. long and 0.2 in. broad, strap-like, sessile, slightly fleshy, olive green on the outside, with a purplish hue on the inner side and along the margins. The first two leaves are simple, opposite and about $1\frac{1}{2}$ in. above the cotyledons. The succeeding leaves are alternate. The 3rd. leaf is oblong-lanceolate, about 3 in. long and $1\frac{3}{4}$ in. broad, entire, acuminate, cuneate and with a short petiole. The midrib and nerves are slightly raised above, but more so below. The nerves are looped. The underside of the lamina is glaucous. The terminal bud is enveloped in a needle like sheath about $1\frac{1}{2}$ in. long, and formed by 2 caducous stipules. The youngest part of the green stem is glaucous. The seedling is glabrous.

(ii) Klainedoxa gracillima Mildbr.

This tree is very similar to K. gabonensis, although possibly not as tall. The leaf is broader and also broadly apiculate rather than acuminate, and the base is usually rounded. The fruit is hard and globose, about $1\frac{3}{4}$ in. long but not depressed.

STERCULIACEAE.

This family is well represented in the High Forest Zone by trees and shrubs, but has few species in the Savannah-Woodland. The introduced Theobroma cacao L. - cocoa - is of great ecomonic importance to the Gold Coast.

The leaves are alternate, simple (sometimes lobed) or digitate; the petiole is often swollen at the base and apex, and the lamina may be set at an angle to it. Stellate hairs are not unusual. Often the slash shows diamond shaped markings reminiscent of Expanded Metal (XPM). The flowers are hermaphrodite or unisexual, usually 5-merous, with the stamens often united into a column and in two whorls. The petals may be absent. The ovary is superior. The fruit is sometimes winged, but is often a follicle.

GENERA. 1. Cistanthera K.Schum. 2. Cola Schott.& Endl. 3. Erythropsis Lindl. 4. Mansonia J.R.Drumm. 5. Pterygota Schott. & Endl. 6. Sterculia L. 7. Tarrietia Bl. 8. Triplochiton K.Schum.

1. CISTANTHERA K.Schum.

Cistanthera papaverifera A.Chev.

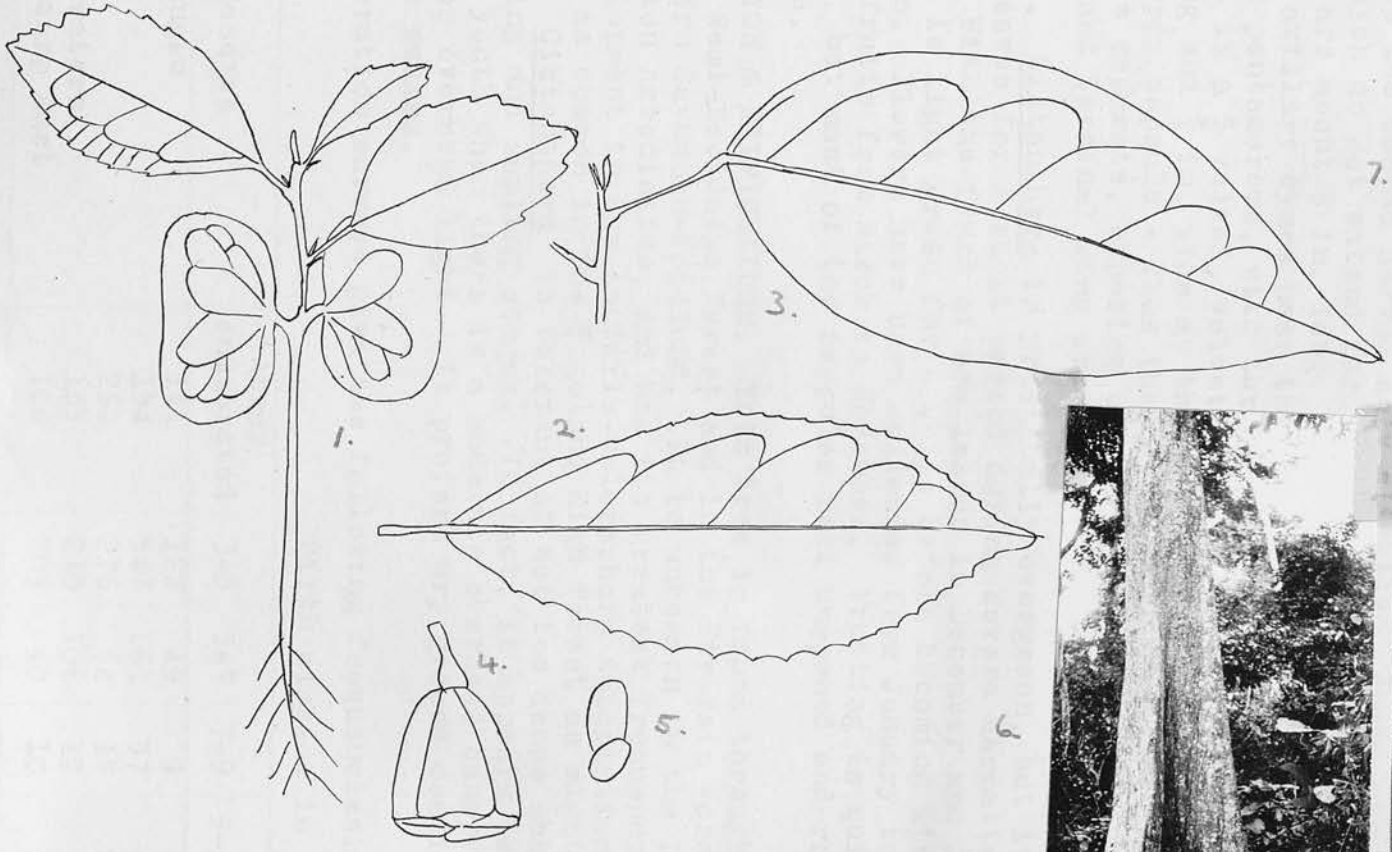
VERNACULAR NAMES. Abumana (Ash). Akumaba (Ash). Banu (Ad). Butuakwa (Western Ash.). Danta (T,W). Epro (Ash,T) .

Akuma means an axe and so Akumaba is derived from the wood being used as axe handles. Danta owes its origin to Danish gun because the wood of this tree was used for gun stocks for the muzzle loaders introduced into the Gold Coast by the Danes - and still known as Dane guns.

A tall, slender tree, whose bole is often not quite cylindrical, and with narrow buttresses which may be 12 ft. hight. The crown is small, rounded and dense in parts. The following measurements were obtained from felled trees:

Girth above buttresses	Length of bole	Height of tree.
8ft. 2in.	110ft. 7in.	162ft. 5in.
11 5	89 1	157 10
12 2	80 5	149 10

The bark is shaggy brown, but may be much darker in its northern limits where it is often growing in exposed conditions. The slash is pink to red and numerous, regular ripple marks are conspicuous in the pinkish sapwood. The heart is reddish-brown, about 46 lb. per cu. ft. at 15% moisture content, hard, strong, lustrous, with an even, fine texture, tough and elastic. It turns well and takes a good polish. In transverse section, the small vessels and the very fine medullary rays may be seen with a hand



Cistanthera papaverifera. 1.Seedling. 2.Juvenile leaf. 3.Leaf. 4.Fruit. 5.Seed. All x 1. 6.Bole. 7.Tree.

lens. In longitudinal section, the ripple marks are obvious. The wood is used for toold handles, gun stocks, chairs and for surf boat ribs and planking.

BOTANY. The leaf is elliptic to obovate, about 3½ in. long and 1 1½ in. broad, entire but serrate on juvenile plants, acuminate and finely mucronate, cuneate to almost rounded at the base, tomentose in the nerve axils on the underside but soon glabrous. The petiole is about ¾ in. long, swollen at the apex and base and the lamina is set at an angle to it. The midrib is raised below, but the looped nerves only slightly. There are two basal nerves which do not extend far. The paired, linear, caducous stipules are about ½ in. long. The yellow-white flowers are borne kn axillary cymes near the ends of the branches. The flower is pentamerous, with three times the number of stamens. The fruit is a 5 valved, velvety, brown, woody capsule, about ¾ in. long and ¾ in. wide at the flattened apex. It is fluted like a poppy capsule - thus the specific name papaverifera. The valves separate, exposing the two seeds in each loculus. The seed and terminal wing are about 0.6 in. long.

PHENOLOGY. Cistanthera is practically evergreen, but it may be bare of leaves for a short period during severe harmattan in January. With the flush of new leaves in December and January, the crown is light green for a while before becoming its usual dark green. Flowers have been collected from January to July, and ripe fruits from March to November. Fruiting is quite plentiful, but most of the capsules fall unopened and rot on the ground.

DISTRIBUTION & SILVICULTURE. This tree is found throughout the Moist Semi-Deciduous Forest and in the Riverain Forest of the southern Savannah-Woodland. It is uncommon in the Lophira-Triplochiton Association, and has its greatest frequency and best development in the Antiaris-Chlorophora Association. It is not as common in the Togoland High Forest as might be expected. Cistanthera is tolerant of not too dense shade in the seedling and sapling stages. In fact, it appears to thrive better in youth when there is a moderate overhead canopy. Later ir requires overhead light. It prefers dry ground conditions, and avoids swamps.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
South Fomangsu	141	122	49	9	-	-
Boumfum	154	543	161	37	-	-
Bia Tano	262	276	64	17	2	-
Afram Headwaters	185	210	106	12		
Northern Scarp East	100	209	40	10	1	2

SEEDLING. Germination is epigeal. The hypocotyl is about 2¼ in. long and covered with a short pubescence. The cotyledons enlarge to become reniform, about ½ in. long and 1 in. broad; the petioles are short. The leaves are simple and alternate. The second leaf is elliptic to narrowly obovate, about 1½ in. long and ¾ in. broad, serrate, acute and rounded at the base. The petiole is bout 0.3 in. long and pubescent, and the lamina is inclined at an angle to it. The paired linear stipules are caducous. The shoot is brown and covered with a short pubescence.

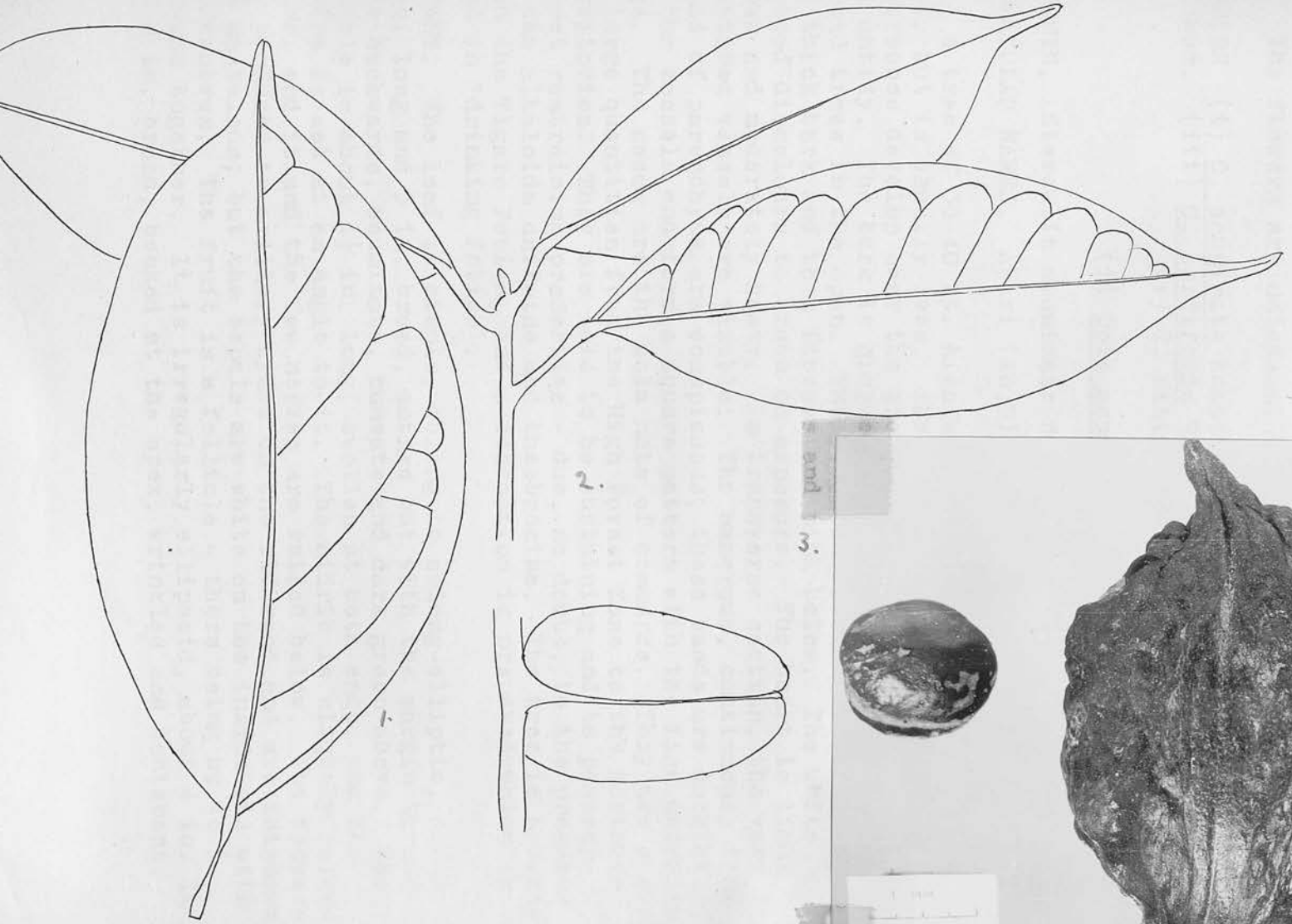
NATURAL REGENERATION. Compared with the large amount of fruit produced, little regeneration is seen. The young seedlings are usually to be found under partial shade. Those which have germinated in the open conditions of new farms are likely to die young. With partial shade the seedling makes steady progress. Once established it will take advantage of overhead light and put on good increment in height. The following measurements of seedlings were taken in Indicator Plots situated in natural regeneration areas worked under the Tropical Shelterwood System:

1st. year	2nd. year	3rd. year	4th. year
8in.	19in.	40in.	70in.
8	10	12	45
4	7	12	23
3	5	6	25
5	7	14	24
9	13	18	33

The young plants retain their branches for quite a while.

ARTIFICIAL REGENERATION. Seeds are difficult to collect as they are small. They have a short viability. Those that fall inside the capsules are usually immature. There are about 1,000 seeds to an ounce. The germination period is 11-26 days and the germination percent about 73. This figure is often considerably smaller because it is not unusual to find that immature seeds have been collected from fallen, unopened capsules. Light shade is required over the seed beds. In the first 6 months the plants grow about 5 in. in height, but at the end of a year are about 23 in. high. In a small planting experiment in Kumasi, stripped plants gave better results than stumped ones. Growth was erratic. At 4 years the plants were 4-16 ft. high and at 14 years 6-54 ft. high and 2in. - 2 ft. 6½ in. G.B.H.

PATHOLOGY. The leading shoots of seedlings and saplings may be killed by aphids.



Cola acuminata. 1.Leaf. 2.Seedling. Both x 1.
3.Fruit & seed.

2. COLA Schott.& Endl.

C. laurifloia Mast. is a small tree associated with water courses in the Savannah-Woodland. The genus is well represented in the Hig Forest by tall and small trees. Some of the latter occur in the Coastal Scrub as shrubs e.g. C. togoensis Engl.& Krause.

The flowers are unisexual and apetalous.

SPECIES (i) C. acuminata Schott.& Endl. (ii) C. chlamydantha K.Schum. (iii) C. cordifolia R.Br. (iv) C. maclaudii Aubrév. (v) C. nitida A.Chev.

(i) Cola acuminata Schott.& Endl.

SYNONYM. Sterculia acuminata Beauv.

VERNACULAR NAMES. Awasi (Ao,S). Bawsi (F). Bise (Ash,T). Esele (Nz).

A tree of 30-40 ft. high and a girth which may go up to 7 ft. but is usually less. The bole is short and short, sharp buttresses develop near the ground. The crown is low, spreading and untidy. The bark is grey and fissured - very dark looking on old trees in the open. The slash shows dull brown through the thick bark and then fibrous and pink below. The white sapwood discolours to brown on exposure. The heart is light brown and moderately heavy. In transverse section, the very few scattered vessels are visible. The numerous, continuous, fine bands of parenchyma are conspicuous; these bands are unrelated to the vessels and form a square pattern with the fine medullary rays. The seeds are the cola nuts of commerce. They are exported in large quantities from the High Forest Zone to the Northern Territories. They are said to be sustaining and to possess thirst restraining properties - due, no doubt, to the presence of the alkaloids caffeine and theobromine. The tree is associated with the Tigare Fetish, and a concoction is prepared which is used in 'drinking fetish'.

BOTANY. The leaf is simple, oblong to oblong-elliptic, about 6 in. long and 3 in. broad, entire but with the margin turned over backwards, acuminate, cuneate and dark green above. The petiole is about 1½ in. long, swollen at both ends, and the lamina is set at an angle to it. The midrib is slightly raised above, and it and the few nerves are raised below. The flowers are produced in axillary cymes on the old wood and are inisexual and apetalous; but the sepals are white on the inside and with red centres. The fruit is a follicle - there being up to 5 grouped together. It is irregularly ellipsoid, about 4 in. long and 3 in. broad, beaked at the apex, wrinkled and dehiscent.

It contains abot 8 seeds - the 'cola nuts' - which are red or white and about 1 in. broad. The white ones are preferred and are called Bisehene (chief's or king's cola).

PHENOLOGY. The tree is evergreen. Flowering takes place from May to July and the fruits are ripe in October to December.

DISTRIBUTION & SILVICULTURE. This is an understorey tree found throughout the High Forest Zone. It is not common in the natural forest but is often cultivated or semi-cultivated in and around villages. It is a shade bearer.

SEEDLING. Germination is hypogeal. The large cotyledons remain in the seed coat and do not develop. The shoot is dark green and covered with a brown indumentum. The leaves are alternate. The lst. leaf is about 9 in. above ground, simple, oblong-lanceolate, about 4½ in. long and 1½ in. broad, entire, acuminate and cuneate, dark shiny green above and pale, dull green below. The petiole is about 0.6 in. long, fairly stout, covered with a brown indumentum and swollen at both ends, and the lamina is set at an angle to it. The midrib is slightly raised above and it and the nerves are raised below.

ARTIFICIAL REGENERATION. Germination is slow, taking about 56 days. Either stripped or stumped plants succeed for transplanting purposes. This species has been used in the Pra-Anum F.R. experimentally for underplanting. Growth has been slow, and the plants when 17 years old were about 14 ft. high and had not had the chance of forming large crowns; nor had they produced fruits by then.

(ii) Cola chlamydantha K.Schum.

VERNACULAR NAMES. Akandawasi (Ao). Kendeba-esele (Nz). Krabise (W). Tenafre (W).

A small tree which may grow up to about 40 ft. high. The poles are used as fufu pestles.

BOTANY. The leaf is digitate, large and with about 7 sessile leaflets. The rhachis may be about 9 in. long. The leaflet is obovate, up to about 12 in. long and 3½ in. broad or larger, entire, acuminate, attenuated at the base. The midrib and few nerves are slightly raised above and more prominently below. The venation is reticulate. The apetalous, unisexual flowers have deep red sepals and are cauliflorous. The fruits are dark re, sessile follicles which become dark brown and look like buches of bananas on the bole of the tree.

PHENOLOGY. The tree is evergreen. Flowering takes place from August to November, and the fruits are ripe in January to March.

DISTRIBUTION & SILVICULTURE. C. chlamydantha is a shade bearing understorey tree of the Rain Forest and the Lophira-Triplochiton Association. In the west it extends up the Tano Valley towards Wiawso. It is usually in quantity where found. It coppices vigorously and is a troublesome weed in areas being treated for natural regeneration of economic species. It is also a host of the virus which causes the Swollen Shoot disease of the cacao tree.

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long. The cotyledons develop and become foliaceous, orbicular, about 2 in. diameter, slightly flattened at the apex, entire, dark glossy green above and light dull green below. The venation is visible. The stout petiole is about $\frac{1}{4}$ in. long. The primary leaves are alternate and simple. The 1st. leaf is elliptic, about 3 in. long and $1\frac{1}{4}$ in. broad, entire, acuminate and cuneate. The petiole is about $\frac{1}{2}$ in. long, swollen at the base and apex, and with the lamina set at an angle. The lower side of the midrib, the petiole and the stem are very slightly pubescent.

FIELD NOTES. The young plant may at first be mistaken for Tarrietia utilis The golden brown stellate hairs on the underside of the Tarrietia leaf are a distinguishing mark.

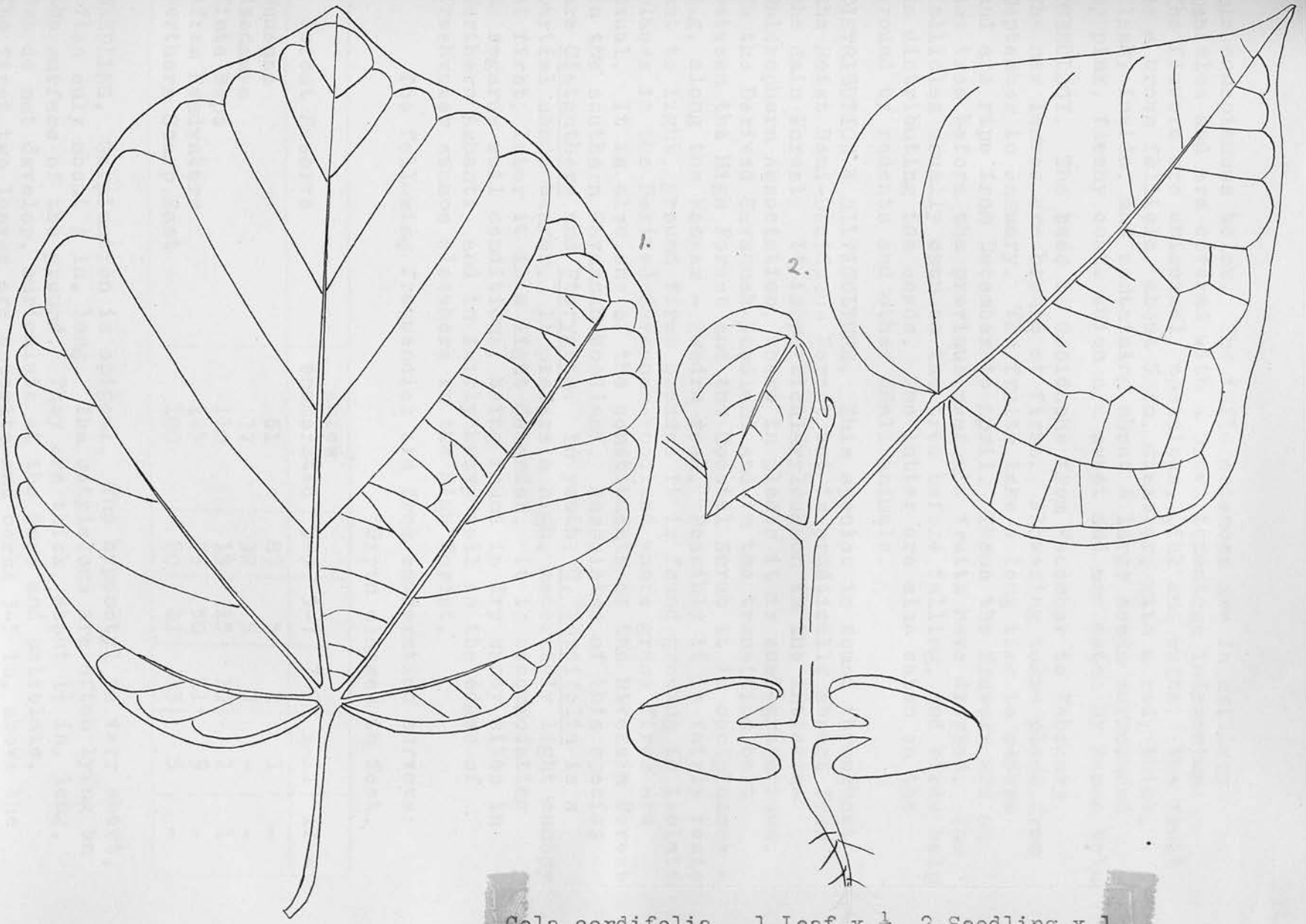
(iii) Cola cordifolia R.Br.

SYNONYMS. C. gigantea A.Chev. Sterculia cordifolia Cav.

VERNZCULAR NAMES. Awari (S). Watapuo (Ash,T). Wawapu (Ash,T,W).

A tal tree of about 130 ft. high or taller sometimes, and a girth of about 8 ft. The bole is slender, but not always straight and cylindrical. The buttresses are narrow and may be 10 ft. high. The crown is rounded, not deep, and composed of large, dark leaves. The light grey bark is fissured longitudinally. The slash is thick, pink, often with vertical white lines, and slightly scented. The sapwood is white. So is the heart, which is about 34 lb. per cu. ft. seasoned, soft and not durable. In transverse section, the few scattered vessels are barely visible. The fine continuous bands of parenchyma are not related to the vessels and intersect the medullary rays to give rectangles.

BOTANY. The leaf is simple, ovate to sub-orbicular, about 7 in. long and 8 in. broad or bigger (27 in. long and 18 in. broad in young plants), entire, obtuse, acute or rounded apex and cordate at the base. (The leaves on young plants are lobed). The stellate hairs on the underside of the lamina disappear in time. The petiole is about 5 in. long and woody. The stipules are triangular, about $\frac{3}{4}$ in. long and 0.3 in. broad at the base, and pubescent on the outside. The leaf is palmately nerved. The midrib and nerves are raised above and below - more so below. The veins, running more or less at right angles to the nerves



Cola cordifolia. 1.Leaf x $\frac{1}{2}$. 2.Seedling x 1.

are conspicuous below. The inflorescences are in axillary panicles and are covered with a brown tomentose indumentum. The flowers are unisexual, apetalous, pink and white. The fruit is a brown follicle, about 5 in. diameter, with a red, thick, fleshy inside, and containing about 6 large seeds surrounded by pink, fleshy coats which are sweet and are eaten by human beings.

PHENOLOGY. The tree is deciduous from December to February. The new leaves are bronze at first. Flowering takes place from September to January. The fruits take a long time to mature and are ripe from December to April. Theus the flowers are on the tree before the previous season's fruits have dropped. The follicles usually open on the tree before falling, and birds help in distributing the seeds. The latter are also eaten on the ground by rodents and other small animals.

DISTRIBUTION & SILVICULTURE. This species is found throughout the Moist Semi-Deciduous Forest but is practically absent from the Rain Forest. It is particularylcommon in the Antiaris-Chlorophora Association, where in places it is semi-gregarious. In the Derived Savannah-Woodland and in the transition belt between the High Forest and the Coastal Scrub it is conspicuous - e.g. along the Nsawam - Swedru road. Possibly it is fairly resistant to light, ground fires because it is found growing in isolated places in the Derived Savannah-Woodland where grass fires are usual. It is also one of the constituents of the Riverain Forest in the southern Savannah-Woodland. Associates of this species are Cistanthera and Pterygota. In youth, C. cordifolia is a partial shade bearer. It prefers a high, moderately light canopy at first; later it is a light demander. It is accommodating as regards soil conditions, being found in dry sandy sites in Northern Ashanti, and in fairly heavy soil on the edges of freshwater swamps elsewhere in the High Forest.

The following frequencies are from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11--
Nsuensa	61	87	5	1	1	-
Asenanyo	77	32	5	3	-	-
Tinte Bepo	110	19	15	10	1	1
Afram Headwaters	185	75	50	21	9	-
Northern Scarp East	100	20	11	13	5	-

SEEDLING. Germination is epigeal. The hypocotyl is very short, often only about ½ in. long. The cotyledons are often lying on the surface of the ground. They are thick, about 1¼ in. long, but do not develop, auriculate at the base and petiolate. The first two leaves are opposite and borne 3-5 in. above the cotyledons. The leaf is ovate, about 3½ in. long and 3 in. broad,

entire, acuminate, cordate, glabrous, palmately nerved, with a petiole about 1¼ in. long, swollen at the apex and base, and stipulate. The succeeding leaves are alternate. The 3rd. leaf shows lobing - usually 3 lobes - and may have a red coloration, which seems to develop quicker in shade. The midrib, nerves and veins are distinct on the underside. The green, triangular stipules are caducous.

NATURAL REGENERATION. This is often found in groups near to the mother tree, especially if the shade is not too dense. The seedlings are sturdy and make good progress. The sapling is typically unbranched; it is robust and may grow up to 27 in. a year in height.

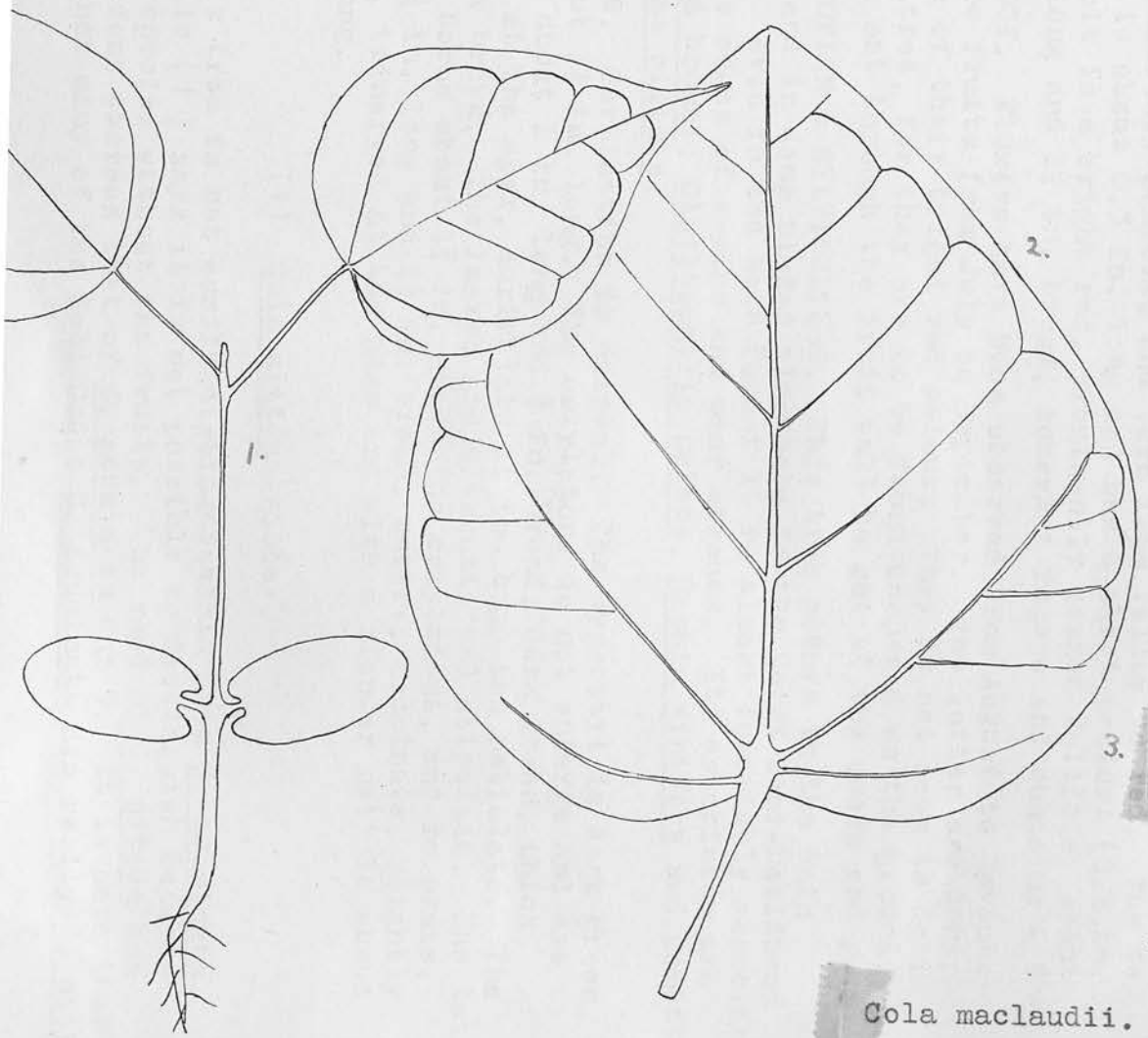
ARTIFICIAL REGENERATION. There are about 8 seeds to an ounce. Germination takes from 16-40 days, and the germination percent is about 78. Growth is vigorous and a height of 4 ft. 5½ in. is recorded for the first year in a nursery where the beds were lightly shaded. Both stripped and stumped plants may be transplanted successfully, but in the latter there is a tendency for more than one shoot to develop at first, although one later assumes dominance.

FIELD NOTES. C. cordifolia and Pterygota macrocarpa are sometimes confused, especially in the seedling and sapling stages. The following spot characters for both species are given:

Character	Cola cordifolia	Pterygota
Cotyledons	Petiolate. Auriculate.	Almost sessile. Oblong.
Young leaf	Red flush.	Green.
" "	Deeply lobed.	Not much lobed.
Sapling stem	Brown on previous year's growth.	Greenish-grey.
Leaf	Veins prominent on underside.	Veins less distinct.
Seed	Wingless.	Winged.
Fruit	Red inside.	Brown inside.
Bark	Fissured.	Smooth.
Slash	Red.	White.

(iv) Cola maclaudii Aubrév.

This species is stated by Aubréville ( ) to be very similar to C. lateritia K.Schum., except for the flowers of the latter having longer pedicels which are articulated at the ends of the peduncles. It is possible that both species exist in the Gold Coast.



Cola maclaudii. 1.Seedling. 2.Leaf. Both x 1.
3.Fruit.

VERNACULAR NAMES. Awari (S). Eholaka (Nz). Ewakpile (Nz). Watapuo (Ash,T). Wawapu (Ash,T,W).
These names, except for the Nzima ones, are also applied to C. cordifolia.

Usually a tree of less than 50 ft. high, with a short, twisted, buttressed bole, and a low, untidy, spreading, dense crown. The bark is thin, dark grey and scaly. The slash is red-brown through the bark, and then a fairly thick, fibrous, light saffron brown or pinkish-brown layer. The white sapwood shows diamond shaped markings.

BOTANY. The leaf is ovate, about 4 in. long and broad, entire, obtuse, cordate, glabrous, palmately nerved and fairly thick, with a stout, dark brown petiole, about $1\frac{1}{4}$ in. long. (The leaves on young plants are larger). The midrib and nerves are very slightly raised above, but prominent below. The veins are not regular and distinct as in C. cordifolia. The unisexual, apetalous flowers are in axillary panicles and turn from yellow to red. The female flower is about 0.3 in. long and has a short pedicel (0.1 in.). The fruit is a bright red. prominently beaked follicle, about 3 in. long and $1\frac{3}{4}$ in. broad, somewhat rugose and contains 6-8 seeds.

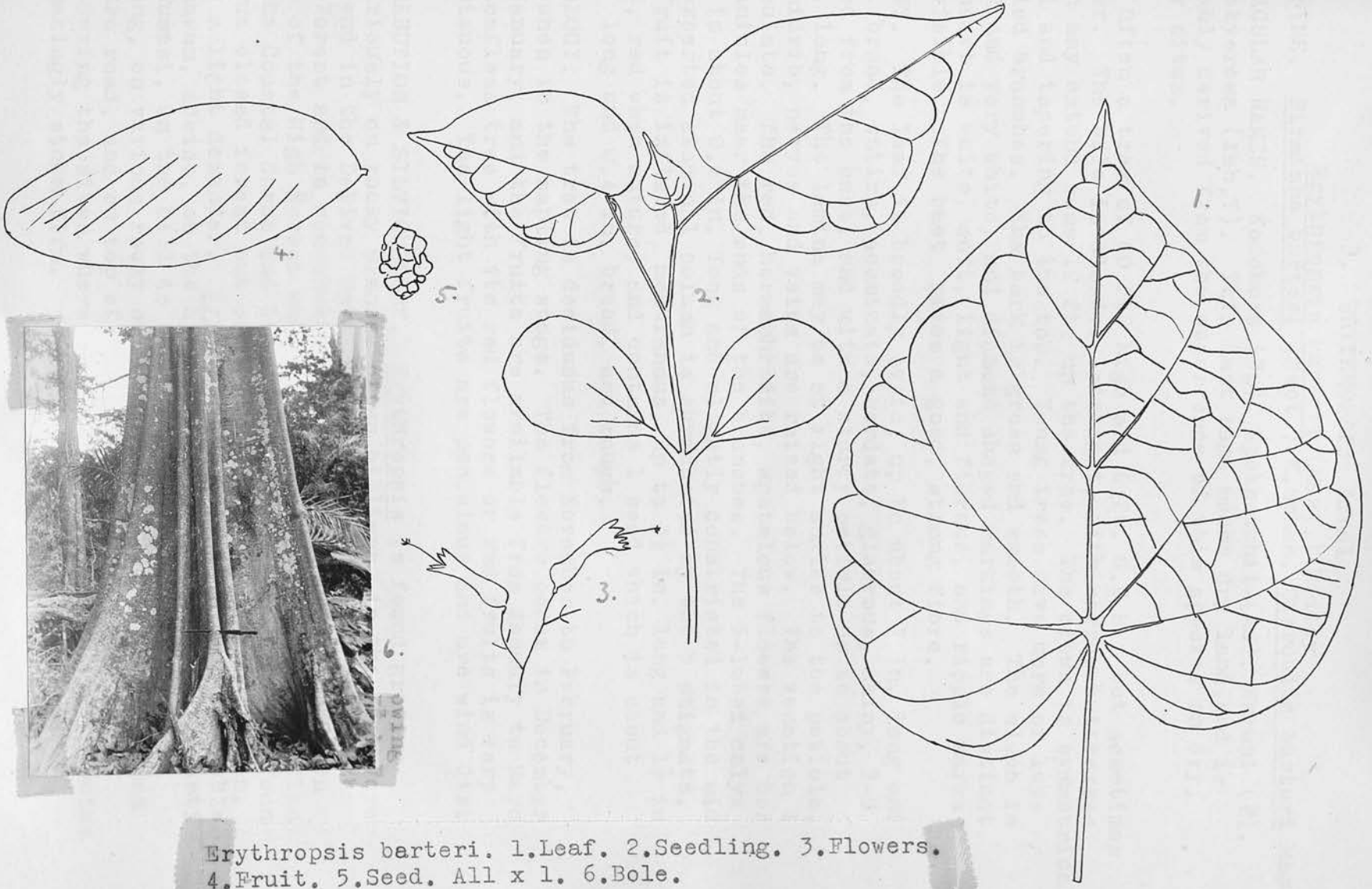
PHENOLOGY. Flowers have been observed from August to November and ripe fruits from July to September. The latter are conspicuous because of their bright red colour. They do not seem to dehisce on the tree, for they are to be found unopened on the ground. Animals eat through the fruit wall to get at the seeds and pulp.

DISTRIBUTION & SILVICULTURE. This tree occurs in the Rain Forest and in damp places elsewhere in the Moist Semi-Deciduous Forest. Even in the Rain Forest it is almost invariably associated with the edges of swamps and near streams. Its associates are Alstonia boonei, Cleistopholis patens, Raphia vinifera and sometimes Mitragyna ciliata.

SEEDLING. Germination is epigeal. The hypocotyl is dark green, and about $1\frac{1}{2}$ in. long. The cotyledons do not enlarge and are oblong, about 1 in. long and $\frac{1}{2}$ in. broad, dark green, thick, rounded at the apex, auriculate at the base and petiolate. The shoot is brown. The leaves are alternate and stipulate. The 1st. leaf is borne about $1\frac{3}{4}$ in. above the cotyledons, and is ovate, about $2\frac{1}{4}$ in. long and $1\frac{1}{2}$ in. broad, entire, acuminate, slightly cordate, trinerved at the base and with a slender petiole about 1 in. long.

(v) Cola nitida A.Chev.

This tree is not easily distinguishable from C. acuminata. Aubréville ( ) says it is not possible to distinguish between the two species without the fruits. The seed of C. nitida has 2 cotyledons whereas that of C. acuminata has 3. It is more than likely that many of the Gold Coast C. acuminata are really C. nitida.



Erythropsis barteri. 1.Leaf. 2.Seedling. 3.Flowers.
4.Fruit. 5.Seed. All x 1. 6.Bole.

3. ERYTHROPSIS Lindl.

Erythropsis barteri (Mast.) Ridley

SYNONYMS. Firmiana barteri (Mast.) K.Schum. Sterculia barteri Mast.

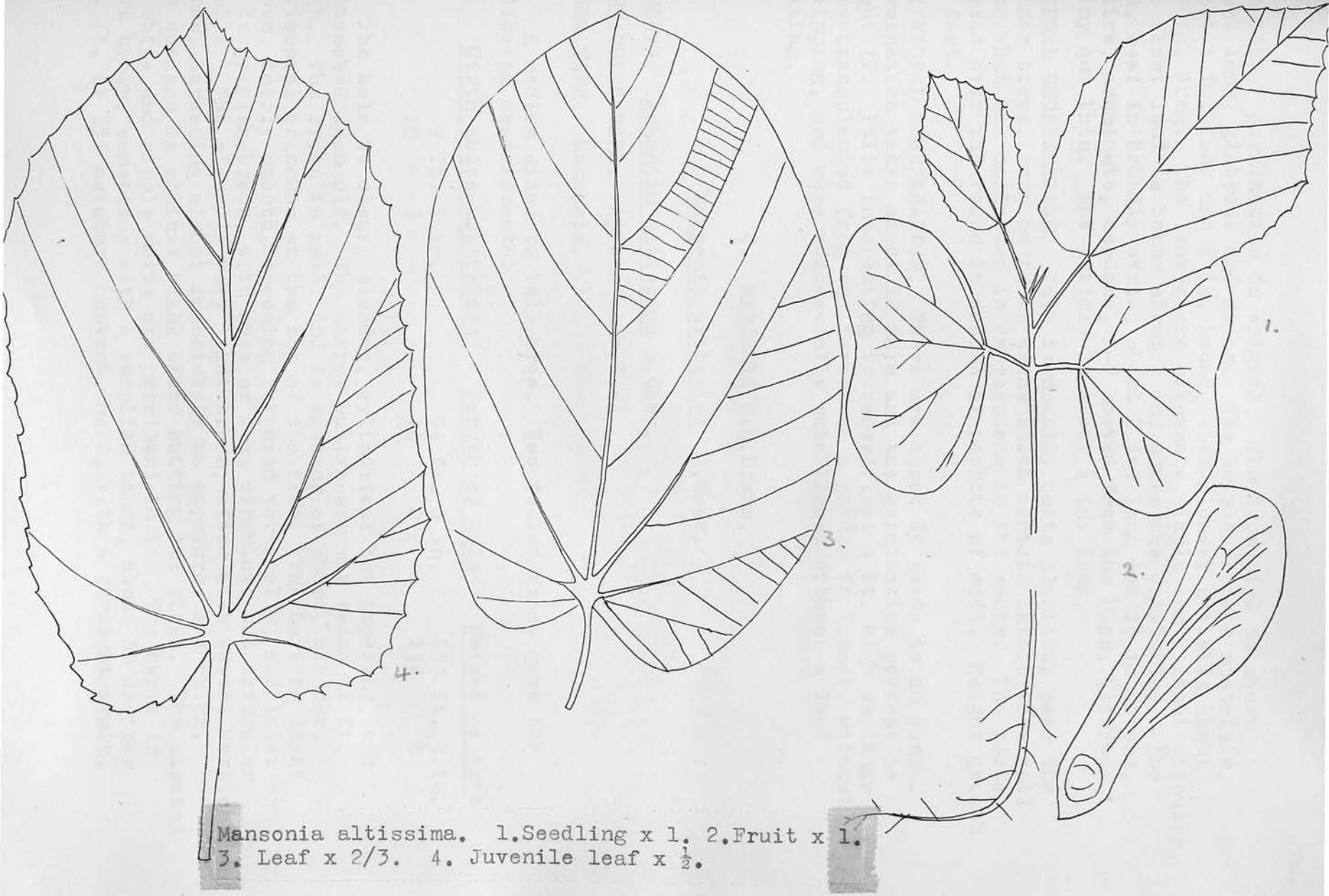
VERNACULAR NAMES. Kodohure (Nz). Kpokpotchii (Ad). Nkruni (F). Nkerekyerewa (Ash,T). This last name means dry land,and is probably derived from the occurrence of this species on dry, rocky sites.

Often a tree of 60 ft. high and 6 ft. G.B.H., but sometimes larger. The bole is slender, straight, with narrow buttresses which may extend some 12 ft. up the tree. The crown is symmetrical, small and tapering to the top. Young trees have more or less whorled branches. The bark is green and smooth. The slash is thick and very white, and diamond shaped markings are distinct. The heart is white, soft, light and fibrous, and ripple marks are visible. The bast gives a good, strong fibre.

BOTANY. The leaf is broadly ovate, up to about 7 in. long and 6 in. broad, entire, acuminate, cordate, glabrous, shiny, 7-9 nerved from the base, and with a sturdy petiole up to about 6 in. long. The lamina may be at right angles to the petiole. The midrib, nerves and veins are raised below. The venation is reticulate. The red, hermaphrodite, apetalous flowers are borne in panicles near the ends of the branches. The 5-lobed calyx tube is about 0.6 in. long and slightly constricted in the middle. The exserted staminal column is surmounted by the 5 stigmata. The fruit is inflated, membranous, up to $3\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. broad, red when mature, and contains 1 seed which is about $\frac{1}{2}$ in. long and 0.4 in. broad, and rough.

PHENOLOGY. The tree is deciduous from November to February, even when in the sapling stage. The flowers occur in December and January, and the fruits are available from January to March. The leafless tree with its red flowers or red fruits is very conspicuous. The light fruits are pendulous and are wind distributed.

DISTRIBUTION & SILVICULTURE. Erythropsis is found growing gregariously on rocky places, often hilltops, in the High Forest Zone and in the Derived Savannah-Woodland. It is rare in the Rain Forest and is commonest along the northern and southern edges of the High Forest where it adjoins the Savannah-Woodland and the Coastal Scrub and Grassland. This species is not found in true closed forest but only where the canopy is very open. It is a light demander. Erythropsis is particulary noticeable at Nsawam, Adeiso, on the hills to the immediate west of Fanti Nyankumasi, on the hill to the east of the Zongo at Ashanti Mampong, on various rocky outcrops along the Sunyani - Dormaa Ahenkro road, and on top of the hill in the Dome River F.R. Considering the sites where this species is found, this species is amazingly storm firm.



Mansonia altissima. 1.Seedling x 1. 2.Fruit x 1.
3. Leaf x 2/3. 4. Juvenile leaf x $\frac{1}{2}$.

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, glabrous and green. The cotyledons are spatulate, about 1 in. long and ¾ in. broad, with slender petioles about 0.2 in. long. The leaves are alternate, simple and without stipules. The first leaf is borne about 1 in. above the cotyledons. The 2nd. leaf is broadly ovate, about 2 in. long and 1¾ in. broad, entire, acuminate, cordate, 5-7 nerved from the base, glabrous, shiny and thin. The petiole is about ¾ in. long.

NATURAL REGENERATION. This is usually quite plentiful near the mother trees, even on rocky areas which contain little more soil than what has collected in depressions in the rocks. The roots spread over the rocks in search of pockets of soil. Height growth is fast.

ARTIFICIAL REGENERATION. There are about 66 seeds to an ounce. Germination takes about 12 days and the germination percent is about 72. Itiis interesting to record that 4 ft. high saplings were transplanted from the forest to a garden in Kumasi, without stripping, and were successfully established without a leaf wilting.

4. MANSONIA J.R.Drumm.

Mansonia altissima A.Chev.

SYNONYM. Achantia altissima A.Chev.

VERNACULAR NAME. Aprono (Ash,T,W).

TRADE NAME. Mansonia.

A medium sized to tall tree. Two felled trees gave the following measurements:

Girth above buttresses	Length of bole	Height of tree
9 ft. 2 in.	94 ft. 0 in.	133 ft. 9 in.
10 3	76 2	144 6

The bole is clear, slender, cylindrical but tapering, and buttressed when old. The narrow buttresses may reach 12 ft. high. The crown is small and is made up of short, slender, horizontal branches at the top of the tree. The bark is light brown, fairly smooth, becoming furrowed vertically, and later on it is greyish-brown, with more or less circular, but irregular scales. The slash is very light brown, often with white, vertical lines, darkening almost immediately on exposure, and thick. The cutlass is stained black after cutting the slash. The sapwood is white and ripple marks are prominent in it. The heart is dark brown, sometimes with a purplish tinge, about 39 lb. per cu. ft. at 15% moisture content, hard, with a straight grain,

fine texture, easy to work and with a high natural resistance to fungi. It is lustrous and takes on a good polish. Some specimens fade to a yellowish colour. With a hand lens the numerous vessels and many, very fine, close medullary rays can be seen in transverse section. There is a tendency for small radial groups of 2-4 vessels. The timber is exported for cabinet work. Sometimes it is used locally for buildings for it splits easily.

BOTANY. The leaves are simple, alternate and large. The leaf is ob-ovate-orbicular, about 5 in. long and 3 in. broad, entire, slightly acuminate, cordate, often unequal sided, usually 7-nerved at the base, and with numerous, fine, tomentose hairs on the underside of the lamina and also some stellate hairs. The midrib, nerves and veins are raised below and the nerves go to the leaf margins without looping. The petiole is 1 in. long or more, tomentose and swollen at the base and apex. The leaf on young trees and saplings may be 12 in. long and markedly dentate. The stipules are triangular and ciliate, about $\frac{3}{4}$ in. long and 0.2 in. broad at the base; they persist for at least a year. The hermaphrodite, scented, white flowers are in axillary cymose inflorescences near the ends of the branches. The flower consists of a fused calyx, 5 petals, 10 stamens and 5 staminodes, and 5 free carpels. The fruit is a samara, about 3 in. long, with 1-5 on a common peduncle. The wing is unilateral, straight on one side and bulged on the other.

PHENOLOGY. The tree is deciduous from February to early April, although an occasional specimen may be deciduous before this. Saplings as small as 6 ft. high are also deciduous. Flowering begins in June and is usually over by the end of August. The flowers are showy and the petals are caducous. The pendulous fruits are conspicuous as soon as they are formed. They are ripe from December to February, and are produced in large quantities. The samara are wind distributed but many may be obtained below the mother trees. Most of them usually remain on the trees until February and then are shed at the same time as the leaves. A tree 30 ft. high and 1 ft. 6 in. G.B.H. has been observed in flower, and trees of 2 ft. G.B.H are capable of bearing both flowers and fruits.

DISTRIBUTION & SILVICULTURE. Mansonia is absent from the Rain Forest. In the Moist Semi-Deciduous Forest it does not occur in the Lophira-Triplochiton Association and is rare in the middle belt of the Celtis-Triplochiton Association. Its greatest frequency is in the Antiaris-Chlorophora Association, except in Togoland where observations have shown it to be not common. It is also fairly common in the outer margin of the Celtis-Triplochiton Association.

Mansonia prefers to have moderate shade for its first two years. In the sapling stage it does best with high light shade, and then becomes a light demander and requires overhead light.

The sapling has well formed branches which are almost horizontal and may be 4 ft. long, but they do not assert themselves and the stem grows straight. This tree prefers well drained, fairly light soils and avoids damp situations.

Enumeration surveys give the following frequencies:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Bia Shelterbelt	75	61	13	7	2	-
Amama Shelterbelt	109	47	24	12	1	-
Bonkoni	170	45	55	21	5	1
Aparapi	47	39	38	16	5	1
Northern Scarp East	100	86	32	9	3	-

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, brown and pubescent. The cotyledons develop, becoming foliaceous, reniform, about 1 in. long and 2 in. broad, showing a marked venation, and with slender petioles about 0.35 in. long. The primary leaves are simple, alternate and stipulate. The 1st. leaf is obovate, about 2½ in. long and 1 in. broad, conspicuously dentate, with a short acumen or acute, cordate, dull green above, and covered with white silky hairs especially on the midrib and nerves below. The petiole is about 1 in. long and slender. The stipules are lanceolate and about 0.3 in. long.

NATURAL REGENERATION. Seed dispersal is good, and in June large numbers of seedlings in the cotyledon stage are to be seen. They are fairly well scattered; those that occur in the forest where there is a high, light canopy progress quickly. It is quite usual to find groups of seedlings in such places growing up to form almost pure thickets, about 10 ft. high, in 5 years. This has happened in parts of the Bobiri F.R. in natural regeneration areas where the lower storey of the forest has been removed by poisoning the unwanted trees. It is not unusual for a sapling to have an annual height increment of about 2 ft. 6 in. Natural regeneration is not usual in Secondary Forest even although many young seedlings may be seen in new clearings.

Some height measurements of seedlings in Tropical Shelterwood System Regeneration plots are as follows:

1st. year	2nd. year	3rd. year	4th. year
8 in.	14 in.	28 in.	53 in.
7	15	57	83
7	18	48	56
7	15	36	60
9	27	73	83
8	28	52	93

ARTIFICIAL REGENERATION. There are about 80 winged fruits to an ounce. The germination period is about 16 days, and the germination 70-85. Often this is considerably less and is due to sowing insect riddled seed. Also, the seed has a short viability and should be sown as soon as it falls from the trees. The seed beds require light overhead screens. The seedling is about 15 in. high at 6 months and up to 3 ft. at a year. (Surplus stock in a nursery grew to 9 ft. in 3 years). It can be planted out at 15 months, either as stripped or stumped plants. Light overhead shade is beneficial until the plants are properly established; plantains are useful nurses. Growth is not uniform. A small plot in Kumasi at the age of 10 years had trees 24-49 ft. high and 8 in.-1 ft. 10½ in. G.B.H.

PATHOLOGY. In March and August, black defoliating caterpillars of a Hypsid moth attack the saplings. It is not usual for the big trees to be defoliated, but a tree about 70 ft. high was seen in August 1952 with the leaves skeletonised down to the nerves. The defoliation seems to cause no real harm, and a flush of new leaves is soon produced.

5. PTERYGOTA Schott.& Endl.

Pterygota macrocarpa K.Schum.

SYNONYM. P. cordifolia A.Chev.

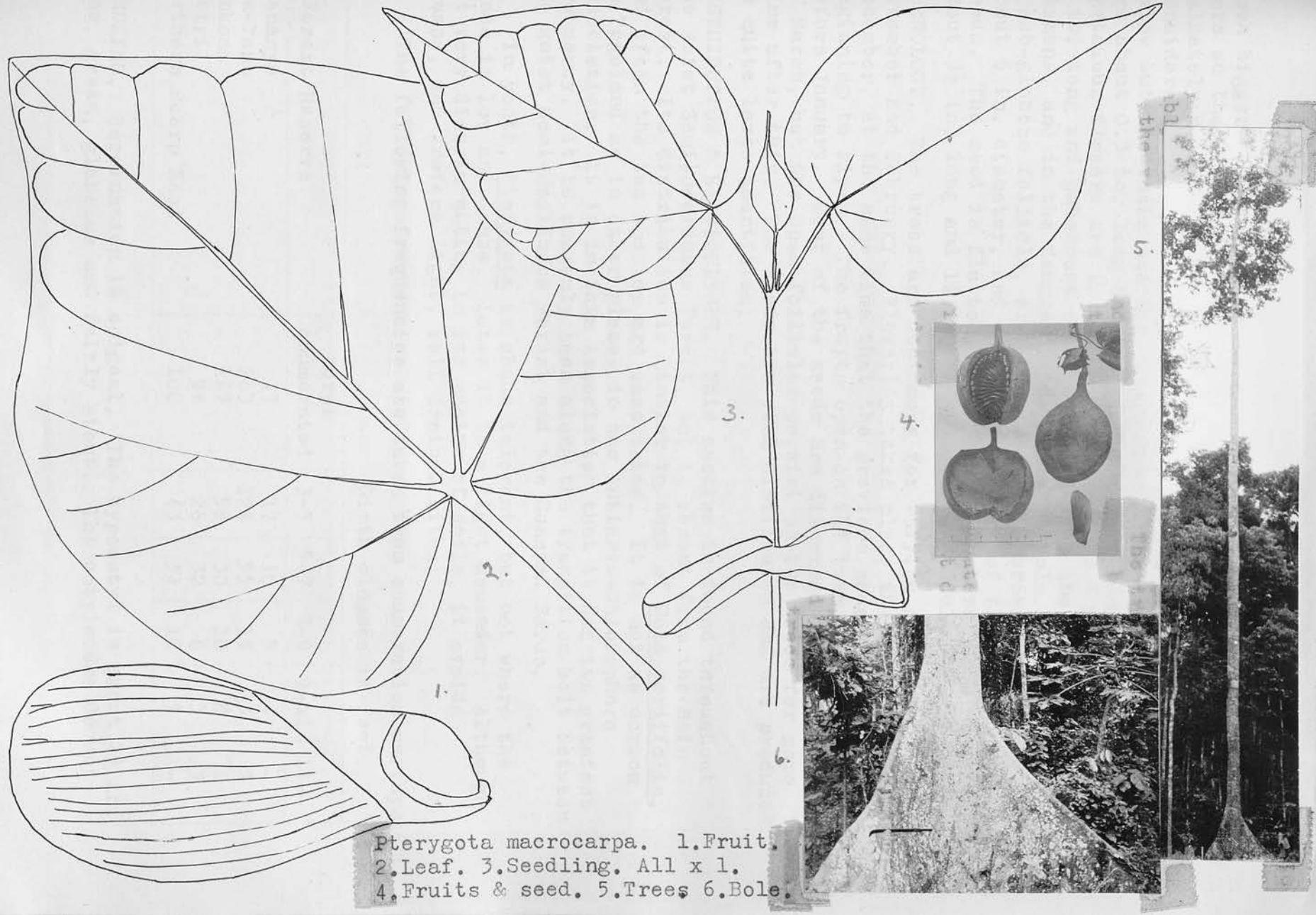
VERNACULAR NAMES. Awari (S). Nokwa (W). Obonawa (Ash,T). Okyere (Ash,T). Ovuga (Ad).
Awari is also used for Cola cordifolia and C. maclaudii.

A tall tree. Felled trees gave the following details:

Girth above buttresses	Length of bole	Height of tree
8 ft. 2 in.	101 ft.	139 ft.
7 10	100	158

The bole is slender, cylindrical, and with large, narrow buttresses raching to about 10 ft. high. The crown is rounded, compact, dense, and although sometimes large in old trees, it is often quite small. In young trees it is conical and close to the stem. The bark is light grey, smooth and with small lenticels in vertical rows. The slash is soft and has a light green, thin, outer layer, and then a thick, white to light brown inner layer often with irregular, more or less vertical lines in it. The sapwood is very light yellow-brown to almost white and has a sheen. The heart is soft, light and yellow-white, and is liable to stain.

BOTANY. The leaves are simple, alternate, large and stipulate. The leaf is ovate-orbicular, about 5 in. long and broad (but



Pterygota macrocarpa. 1.Fruit.
2.Leaf. 3.Seedling. All x 1.
4.Fruits & seed. 5.Trees 6.Bole.

much bigger on young plants), entire, acute, cordate (usually more so than in Cola cordifolia), glabrous, glossy green above, palmately nerved, and with a stout petiole 2 in. long or considerably more. The midrib and nerves are prominently raised below but the veins are not conspicuous. The triangular stipules are about 0.3 in. long and 0.15 broad at the base. The unisexual, apetalous flowers are in terminal cymes. The 5 sepals are about $\frac{2}{4}$ in. long and pubescent on the outside. In the male are 10 stamens, and in the female 5 coalescent carpels. The fruit is a sub-globose follicle, slightly flattened, brown and semi-woody, about 6 in. diameter, and containing 2 rows of tightly packed seeds. The seed is flattened and has a unilateral wing, and is about $3\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad, and light dull brown.

PHENOLOGY. The trees are deciduous for varying periods between November and February. Flowering takes place in November and December, at the same time that the previous season's fruits are beginning to ripen. The fruits open on the tree, but often not before January. Most of the seeds are dispersed before the end of March, but the open follicles persist on the trees for some time after this. The seeds are wind distributed and are produced in quite large quantities.

DISTRIBUTION & SILVICULTURE. This species is found throughout the Moist Semi-Deciduous Forest, but is absent from the Rain Forest. Its distribution is similar to that of Cola cordifolia, and often the two species are associates. It is not as common in Togoland as in other places in the Antiaris-Chlorophora Association. It is in this Association that it has its greatest frequency. It is commonly seen along the transition belt between the Moist Semi-Deciduous Forest and the Coastal Scrub.

In youth, Pterygota is shade tolerant, but not where the shade is low and dense. Later it is a light demander. Although not very discriminating in its choice of soils, it avoids swamps, and prefers light, well drained sites.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Asemanyo	77	17	10	5	-	-
Bia-Tano	263	124	55	15	13	2
Bonkoni	167	59	30	10	8	1
Bobiri	94	26	32	6	3	3
Northern Scarp East	100	43	34	18	5	-

SEEDLING. Germination is epigeal. The hypocotyl is about $2\frac{1}{2}$ in. long, green, glabrous and fairly stout. The cotyledons do not

develop and are oblong, about 1 in. long and 0.6 in. broad, very slightly petiolate, auriculate at the base and curl over at the margins. The first two leaves are opposite and are about 2 in. above the cotyledons. The leaf is simple, broadly ovate, about 3 in. long and 2½ in. broad, entire, acuminate, cordate, thin, light green, glabrous and palmately nerved. The slender petiole is about ¾ in. long. The linear stipules are caducous. The succeeding leaves are alternate.

NATURAL REGENERATION. This is quite common, especially in those parts of the forest where there is high shade. It is often intermixed with Cola cordifolia which it resembles in the sedling and sapling stage, but is without a red flush.

ARTIFICIAL REGENERATION. There are about 30 winged seeds or 36 wingless ones to an ounce. Germination takes about 18 days. In a small experiment in Kumasi, stripped plants gave satisfactory establishment, and in 10 years were 16ft. - 19ft. 9in. high and 5in. - 8 in. G.B.H.

FIELD NOTES. See Cola cordifolia.

6. STERCULIA L.

The flowers are unisexual and apetalous.

In the Savannah-Woodland there is the small tree Sterculia setigera Del. (syn. S. tomentosa G.& P.).

SPECIES. (i) S. elegantiflora Hutch.& Dalz. (ii) S. rhinopetala K.Schum. (iii) S. tragacantha Lindl.

(i) Sterculia elegantiflora Hutch.& Dalz.

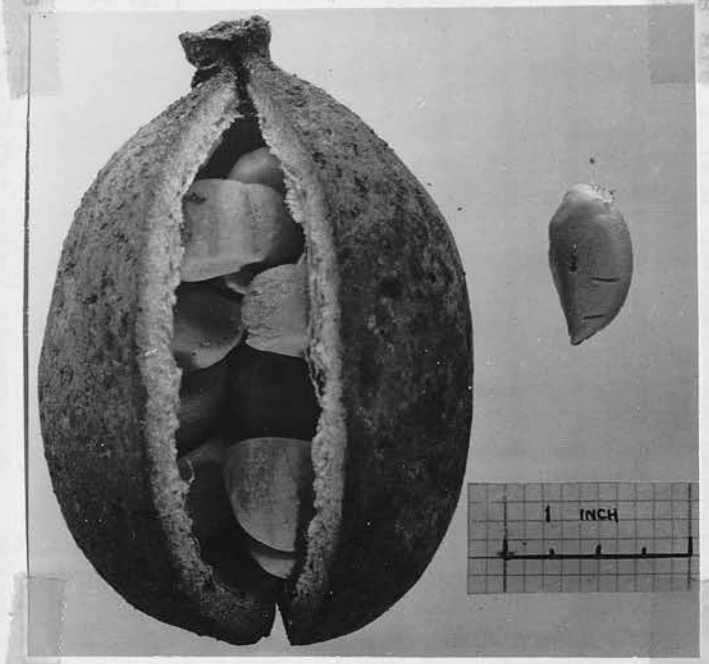
S. oblonga Mast. and this species are very similar, and the difference is the glaborous leaves in the former. (20)

SYNONYM. S. oblonga A.Chev.

VERNACULAR NAMES. Oha (Ash,T). Awari (S) has also been recorded but this is used for Cola cordifolia and Pterygota and therefore must be considered rather vague.

TRADE NAME. Yellow Sterculia.

A felled tree had a height of 116 ft., a bole length of 80 ft. and 9 ft. 7 in. G.B.H. The bole is seldon above 10 ft. girth, abd is fairly straight and clear. The buttresses are narrow, close to the stem and may extend upwards for 10 ft. in the older trees. The crown is light and does not spread much. The bark is light grey and slightly scaly. The slash is white to slightly yellow, fibrous, with a slight smell, and shows diamond shaped markings. The sapwood is white. The heart is



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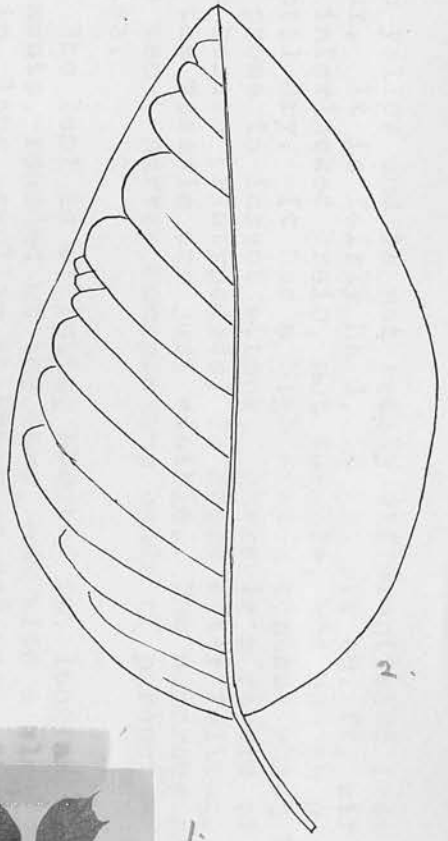

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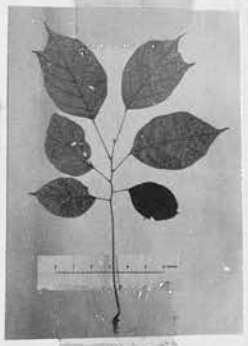


1.

Sterculia elegantiflora. 1.Seedling.
2.Leaf x 1. 3.Fruit & seed. 4.Tree.

white to yellow and is not really differentiated from the sapwood in colour. It is fairly hard, 50 lb. per cu. ft. air dry, often with an interlocked grain, not durable, and has an unpleasant odour until dry. It has a high starch content which renders it very prone to insect attack. There is a record of attack by pin-hole borers (Platypodids) 18 hours after felling. In transverse section the vessels are just visible. The numerous medullary rays and many, narrow conspicuous bands of parenchyma form small rectangles.

BOTANY. The leaf is elliptic, about 4 in. long and 2¼ in. broad, entire, acute, rounded at the base, and with a slender petiole about 1 in. long, swollen at the base and apex, and downy. The lamina is slightly shiny above, dull below, and with a sparse covering of stellate hairs which disappear in time. The midrib and nerves are raised below; the nerves have a uniform appearance on the underside. The linear stipules, about 0.2 in. long, are early caducous. The small flowers are in axillary, scented cymes near the ends of the branches, and are apetalous, unisexual and pentamerous. The fruit is a follicle, oblong, about 5 in. long and 2 in. broad, thick, hard, slightly woody, light dull greenish-grey, containing about 24 seeds. The seed is about 0.8 in. long and 0.35 in. broad, black, hard, but entirely covered with a dull yellow aril. The juvenile leaf is narrowly obovate, 6 in. long and 3 in. broad or larger. Many have the peculiar of being 'horned' at the apex.

PHENOLOGY. The tree is deciduous for a short period, not usually extending beyond September. Flowering takes place from August to October. Ripe fruits are available from the end of November to February. The follicles open on the tree, but many seeds are found attached to the follicles found on the forest floor. Some of the fruits persist on the tree for quite a long time.

DISTRIBUTION & SILVICULTURE. S. elegantiflora is found throughout the Moist Semi-Deciduous Forest. It does penetrate into the Rain Forest but is uncommon there. This species appears to be more common in Sefwi than elsewhere. The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Onuem-Nyamibe Shelterbelt	62	13	8	6	-
Asenanyo	77	27	10	4	-
Bobiri	94	18	7	2	2

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long. The cotyledons become foliaceous, orbicular, about 1 in. diameter, veined, light green and with a petiole about 0.2 in. long. The primary leaves are simple, alternate and stipulate. The 1st. leaf is about 1 in. above the cotyledons, elliptic, about $3\frac{1}{2}$ in. long and $1\frac{1}{2}$ in. broad, entire, acuminate, broadly cuneate, light green, and with a slender petiole about $\frac{1}{2}$ in. long. The next few leaves are 'horned' - usually with three 'horns', but the number varies. (Such leaves cease to occur when the sapling is over about 5 ft. high, or even earlier). The stipules are linear, about 0.2 in. long and caducous. There is a slight pubescence on the nerves, petioles, shoot and hypocotyl.

NATURAL REGENERATION. This is found dispersed, especially where high, light shade exists, as in areas being treated under the Tropical Shelterwood System. The young plants are conspicuous because of their 'horned' leaves. The young sapling produces relatively heavy branches, up to about 3 ft. 6 in. long, set obtusely to the stem. The annual height increment in the sapling stage is about 12 in.

ARTIFICIAL REGENERATION. There are about 14 arillate seeds to an ounce. The germination period is about 12 days and the percentage germination as high as 95. In a small experimental plot in Kumasi, the following measurements were recorded at 9 years:

Height 10 ft. to 48 ft., average 22 ft.
G.B.H. $3\frac{1}{2}$ in. to 1 ft. 4 in., average 9 in.

(ii) Sterculia rhinopetala K.Schum.

SYNONYM. S. oblongifolia A.Chev.

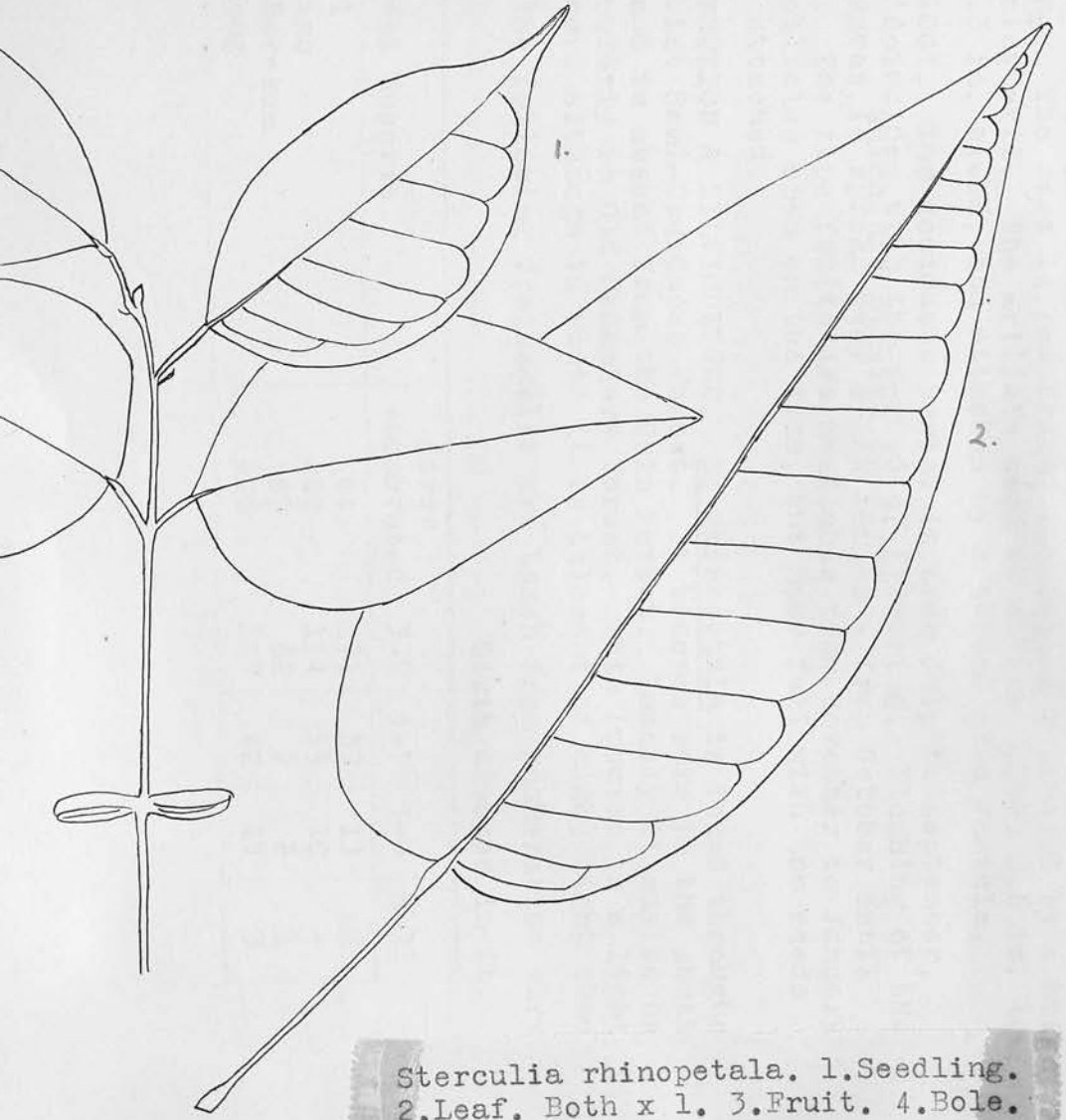
VERNACULAR NAMES. Awasia (S). Wawabima (Ash,T).

TRADE NAME. Brown Sterculia.

A tree of the upper canopy, but not emergent, about 130 ft. high, and usually less than 9 ft. girth. Two trees, when felled, gave the following measurements:

Girth breast height	Length of bole	Height of tree
4 ft. 2 in.	70 ft.	136 ft.
6 3	80	113

The bole is straight, clear and cylindrical. The narrow buttresses may be 8 ft. high, but are usually smaller. The crown is rather open, untidy, fairly close to the stem, and with slender, fairly short branches. The bark is brown, shaggy, with thin, narrow, long scales. The slash is thick, red, fibrous, usually with vertical white lines which become light brown on exposure. The white sapwood shows diamond shaped markings. The heart is



3.

4.

Sterculia rhinopetala. 1.Seedling.
2.Leaf. Both x 1. 3.Fruit. 4.Bole.

reddish-brown, moderately heavy, about 45 lb. per cu. ft. air dry, hard, fairly straight grained, fibrous, with a coarse texture and reasonably durable. In transverse section, the numerous fine medullary rays and the vessels can be seen. Gum is visible in the vessels in longitudinal section. As the wood splits easily and is sufficiently durable for the purpose, it is used for frames in native mud houses.

BOTANY. The leaf is oblong-lanceolate, about 6 in. long and 2½ in. broad and larger, entire, broadly acuminate, rounded or subcordate at the base, glabrous except at first when it has brown stellate hairs on the lamina and petiole. The petiole is slender, about 2 in. long, swollen at the apex and base. The stipules are almost linear, about ¾ in. long, caducous and covered with a brown down. The midrib and widely spaced, looped nerves are raised below. There is a close, brown indumentum on the young shoots. The small, yellow-green, apetalous, unisexual, pentamerous flowers are borne in large numbers towards the ends of the branches. The fruit is a follicle, about 2½ in. long and 1¼ in. broad, hard, slightly woody and quite thin. It contains about 10 seeds, arrange in 2 rows - one on either side of the opening. The seed is red-brown, but entirely covered by a bright red shiny aril. The arillate seed is oblong, about 0.6 in. long and 0.3 in. broad, and attached by a thread like funicle.

PHENOLOGY. The deciduous period is from July to September, which coincides with the period of flowering. Flushing of the new leaves, which are pinkish at first, is spread over a few months - from October until March. The ripe fruits are available from November to January. The follicles open on the tree, but many fall with the seeds still attached.

DISTRIBUTION & SILVICULTURE. S. rhinopetala is found throughout the Moist Semi-Deciduous Forest. It becomes rare in the south-west and is absent from the Rain Forest. Locally it may be common, particularly in Old Secondary Forest. This species is a light demander, although in youth it is tolerant of high, light shade.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in ft. 3-5	5-7	7-9	9-11
Bobiri	94	71	37	13	1
Bia-Tano	262	154	55	10	-
Pamu-Berekum	82	62	7	2	1
Worobong	278	117	42	15	3

SEEDLING. Germination is epigeal. The hypocotyl is about 3 in. long, green but covered with a short, brown pubescence. The cotyledons do not develop and curl along the edges. The first two leaves are borne about 1½ in. above the cotyledons, and are simple and opposite. The leaf is ovate, about 2½ in. long and 1½ in. broad. Succeeding leaves are alternate. The 3rd. leaf is elliptic, about 2½ in. long and 1¼ in. broad, entire, acuminate, rounded at the base, lighter green below, glabrous, and with a petiole about ½ in. long and swollen at both ends. The stipules are small, green and caducous.

NATURAL REGENERATION. This is quite common, not in the dense parts of the forest, but under partially opened canopies. It is frequent in areas being treated under the Tropical Shelterwood System, where the lower canopy has been removed by poisoning. Growth is steady, and the sapling has an annual height increment of about 18 in. where the canopy is fairly high. Quite strong branches, about 45° to the stem, are formed in the sapling.

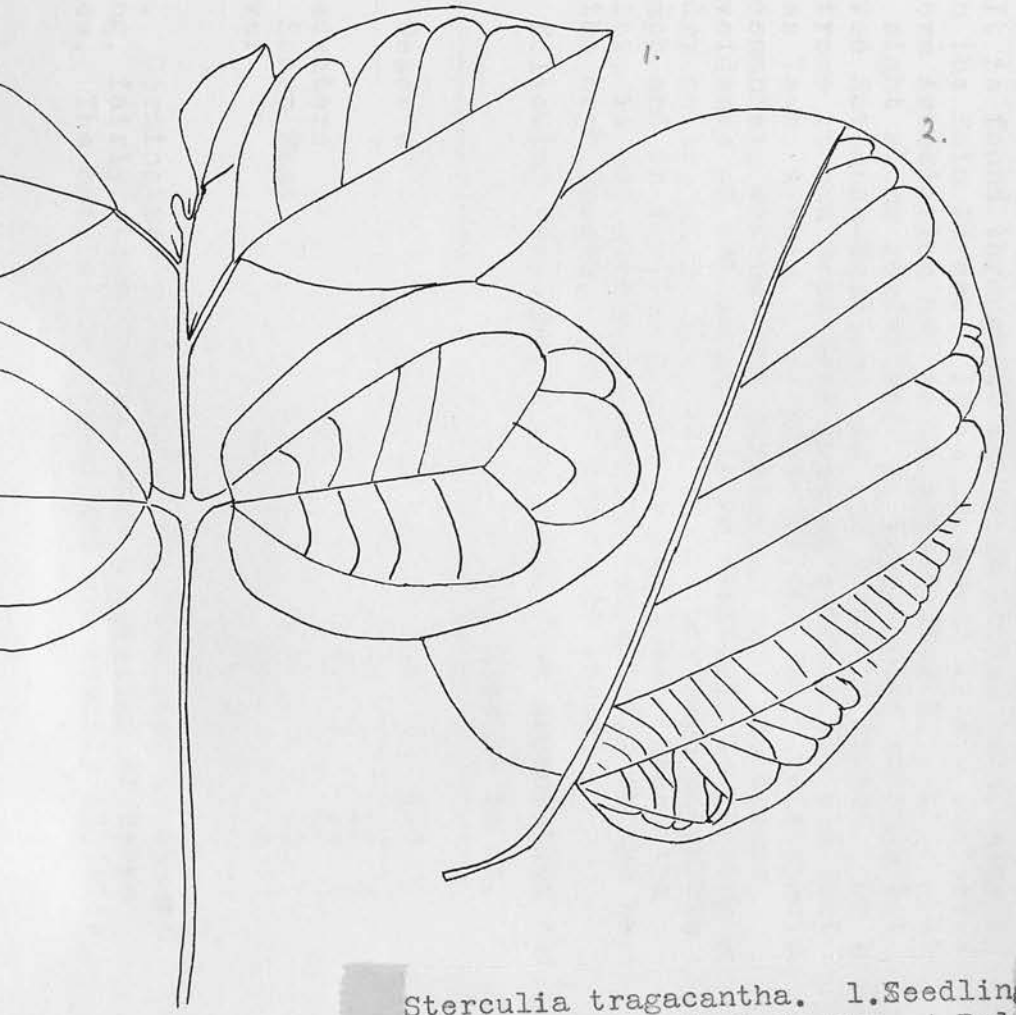
ARTIFICIAL REGENERATION. There are about 59 arillate seeds to an ounce. The germination period is about 8 days and a germination percent of 94 has been recorded.

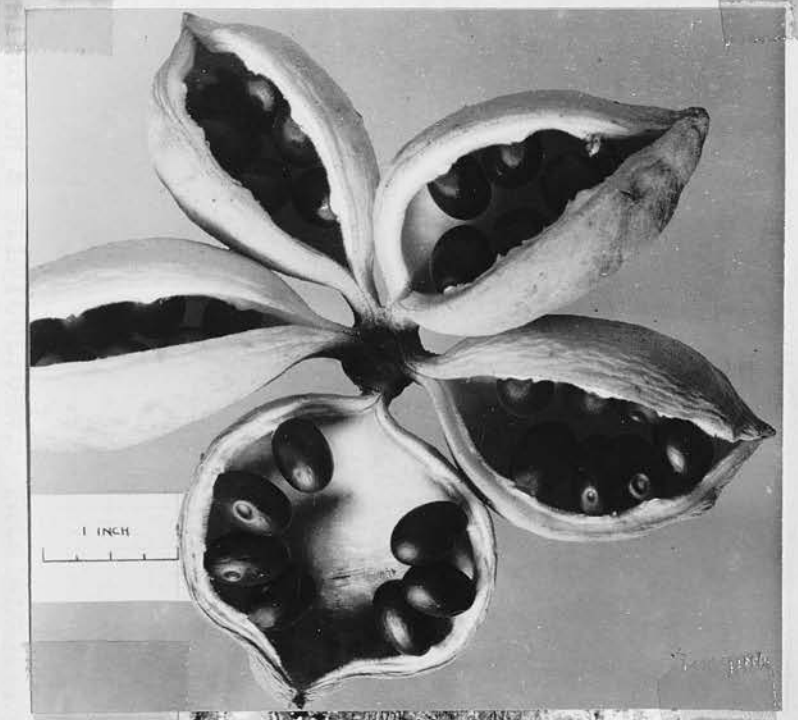
(iii) Sterculia tragacantha Lindl.

SYNONYMS. S. obovata R.Br. S. pubescens G.Don.

VERNACULAR NAMES. Akple (E). Kodohiri (Nz). Kotekyi (Ao). Loloe (E). Sofo(Ash.F,T,W).
Also known as the African Tragacanth.

A small to medium sized tree. It may attain a height of 80 ft. and a girth of 7 ft., but often it is smaller. The bole has small buttresses and is typically short, with a deep crown. In closed High Forest conditions, the bole may be 50 ft. long and the crown rounded and fairly dense. The bark is light grey in closed forest to dark grey in the open, with long thin scales but sometimes fissured. The slash is light brown, fairly thick, fibrous and darkening on exposure. At times a white gume is exuded from wounds. Diamond shaped markings are conspicuous. Large vessels are visible in the white sapwood. The heart is pinkish but becomes brown. It is light, soft, woolly and with a coarse texture. In transverse section the vessels and the medullary rays are visible. The fibrous inner bark is sometimes used for rope. The Elmina people cook kanki dough balls in the leaves. This species is sometimes planted in front of a chief's house as an alternative to the more usual Ficus. This choice is because of the pseudo-whorled branches - cf. Alstonia.





3.

4.

Sterculia tragacantha. 1.Seedling.
2.Leaf. Both x 1. 3.Fruits. 4.Bole.

BOTANY. The leaf is simple, slightly obovate, about 4 in. long and 3 in. broad, but often bigger, entire, rounded at the apex or with a short acumen, slightly cordate at the base, coriaceous, red pubescent below and with a rufous petiole about 1 in. long. The midrib and nerves are raised below and the regular veins are almost parallel with one another. The pubescence is stellate and tends to disappear in time. The stipules are narrow, about 0.4 in. long and stellate pubescent. The flowers are unisexual, apetalous, reddish-brown, slightly scented, and crowded in panicles near the ends of the branches; the bracts are caducous. The fruit is s follicle, about 2 in. long and 1¼ in. broad; there are usually 5 together, arranged in a star formation. The follicle is reddish-brown, hard, thin walled, downy inside and containing about 8 seeds in 2 rows. The seed is ellipsoid, about ½ in. long, dark grey hard, with a thin, black enveloping aril.

PHENOLOGY. The tree is deciduous in December and January. Flowering begins in January and is particularly then because the reddish-brown panicles are borne on the leafless tree. Flowering continues into February. The fruits are mature from October to December and the follicles dehisce on the tree.

DISTRIBUTION & SILVICULTURE. This species enjoys a wide distribution. It is found throughout the High Forest Zone, although common in the Rain Forest. It is commonest in the Antiaris-Chlorophora Association and in Secondary Forest. It is quite frequent sight along roadsides. S. tragacantha extends into the Derived Savannah-Woodland and the Riverain Forest. On the other extreme it has been note growing outside the old fort at Princes Town, within a few yards of the sea. This species is a light demander, without any particular soil preference except avoidance of wet areas. It is adaptable to growing on shallow,dry soils, as on therocks on the northern outskirts of Kintampo and in various places in Togoland. Given the opportunity, it may colonise openings, especially on the northern edge of the High Forest. Height growth is rapid.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Ht. classes in ft. 3-5	5-7
Bobiri	94	37	10
Afram Headwaters	185	37	13
Northern Scarp East	100	52	3
Odomi River	43	26	4

SEEDLING. Germination is epigeal. The hypocotyl is about 4 in. long, fairly stout, green, with a covering of brown pubescence. The cotyledons expand and are broadly elliptic,

about 2¼ in. long and 1½ in. broad, rounded at the apex, slightly auriculate at the base, veined and with ¼in. long petioles. The primary leaves are alternate, simple and stipulate. The first one is broadly elliptic, about 2½ in. long and 1½ in. broad, entire, acuminate, rounded at the base, light green, shiny above, dull below and with a petiole about ½ in. long. The stipules are brown and acicular. The stem and petioles are pubescent.

ARTIFICIAL REGENERATION. There are about 54 arillate seeds to an ounce. The germination period is about 19 days and the germination percent abou 88.

FIELD NOTES. These three species of Sterculia are not usually confused but the following differances may be useful for field identifications:

Character	S.elegantiglora	S.rhinopetala	S.tragacantha
Slash.	White to yellow.	Red with white vertical lines.	Light brown.
Leaf	Elliptic.	Oblong-lanceolate.	Slightly obovate.
Cotyledons	More or less orbicular.	Not developing.	Broadly elliptic.
Primary leaves, 1st. pair	Alternate.	Opposite.	Alternate.
Follicle wall	Thick.	Thin.	Thin.
Aril	Yellow.	Red.	Black.

7. TARRIETIA Bl.

Tarrietia utilis Sprague

SYNONYMS. Cola proteiformis A.Chev. Heretiera utilis Sprague
Triplochiton utile Sprague

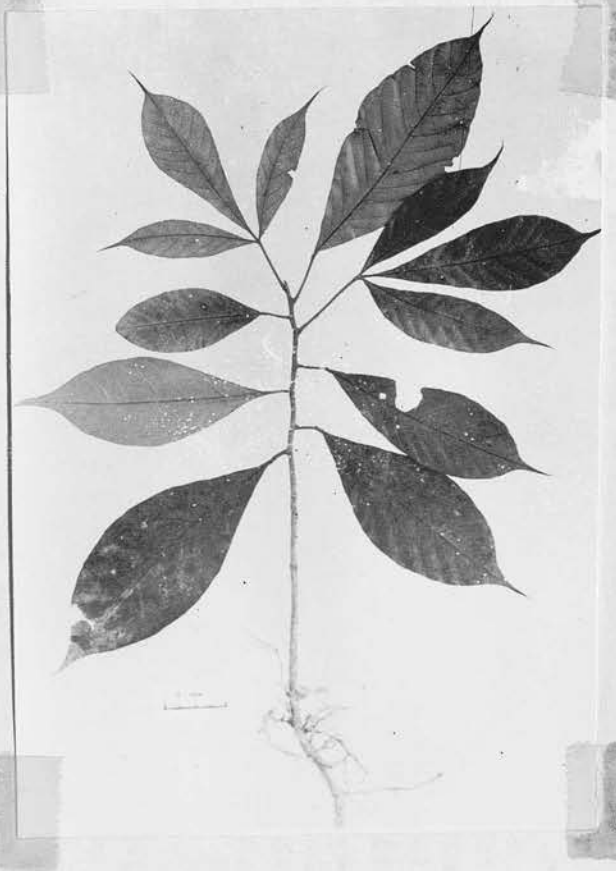
VERNACULAR NAMES. Nyanwen (Ao). Nyangonle (Nz). Nyankom (Nz,W).

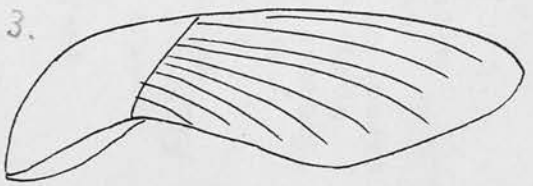
TRADE NAME. Nyankom.

A tall, slender tree. Two felled specimens gave the following measurements:

Girth above buttresses	Length of bole	Height of tree
8 ft. 9 in.	84 ft. 7 in.	151 ft. 11 in.
10 0	80 5	151 5

The stem is straight and cylindrical. The buttresses often develop into stilt roots and the tap root system disappears. The crown is fairly compact and somewhat rounded; it is golden coloured when viewed from below. The bark is light coloured,





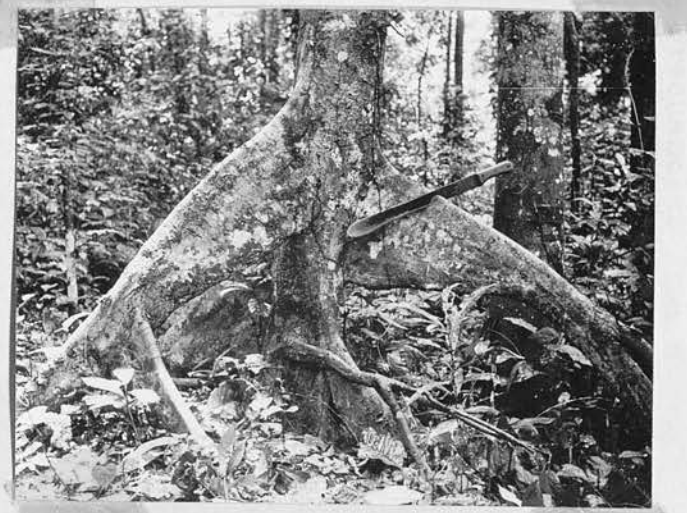
Tarrietia utilis. 1.Leaf x ½.
2.Seedling. 3.Fruit x 1.

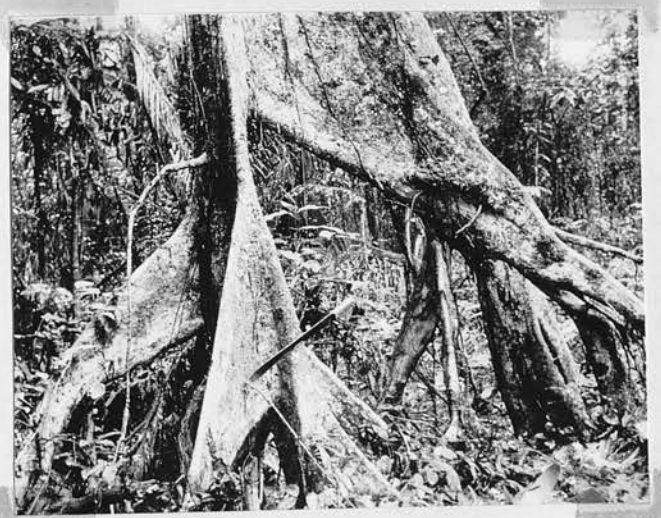
fissured vertically and peeling off in thin narrow scales. The moderately thick, fibrous slash shows a brown outer layer and a pinkish inner layer. Sometimes it resembles the slash of Khaya ivorensis but is not scented. The vessels are conspicuous in the white sapwood. The heart is pinkish at first but darkens to reddish-brown, about 35 lb. per cu. ft. at 12% moisture content, fairly coarse texture but easily worked. It is not resistant to insects and decay. In transverse section a few scattered vessels can be seen, but the fine, numerous medullary rays are hardly visible. Seen through a hand lens the rays appear slightly redder than the wood. As the wood is resinous, it is not a good subject for veneering. It is sometimes used as a mahogany substitute. River canoes are made from it in the Rain Forest where the usual canoe tree, Triplochiton, is absent.

BOTANY. The leaves are alternate and digitate, comprising 5-7 leaflets, and stipulate. However, simple leaves may be produced on flowering branches and directly on the leading shoot. The basal leaflets of the digitate leaf are the smallest. The middle one is oblong-lanceolate, about 8½ in. long and 2¼ in. broad, but much larger in young plants, entire, sharply acuminate, attenuated at the base, shiny green above and golden below because of the golden stellate hairs. At first the whole leaf and young shoot are covered with stellate hairs, but they disappear except from the underside of the leaves. The leaflet has a short petiolule. The pubescent rhachis is about 3½ in. long, and slightly swollen at the base and apex. The midrib and nerves are prominently raised below and slightly raised above. The simple form of leaf is oblong-elliptic, about 5 in. long and 2 in. broad, or larger, entire, acuminate, cuneate to rounded, and with a petiole about 1½ in. or more long. The small, white, unisexual, apetalous, pentamerous flowers are borne in axillary panicles towards the ends of the branches. The fruit is a samara, about 2¾ in. long, dull brown, with the unilateral wing set obliquely to the pointed seed.

PHENOLOGY. T. utilis is evergreen. Flowering takes place between August and October and the fruits are mature from January to March. They are wind distributed, but are not very light and do not travel far. The tree does not appear to produce a large quantity of fruits. Rodents eat the seeds on the ground.

DISTRIBUTION & SILVICULTURE. This species is found in the Rain Forest and in the Lophira-Triplochiton Association of the Moist Semi-Deciduous Forest. A few specimens exist outside this range in Sefwi. Tarrietia is often gregarious and its occurrence is erratic. To the immediate west of the Fure Headwaters F.R., the count per square mile of this species over 6 ft. girth above buttresses came to 890. Tarrietia is a light demander, but the





Tarrietia utilis. Formation of stilt roots.

seedlings and saplings are capable of thriving under high shade; they cannot stand low dense shade. It is tolerant of varying sites and is found on well drained slopes and also in swampy areas. The best shaped boles occur where the drainage is good.

Frequencies from enumeration surveys are as follows:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Cape Three Points	129	80	36	16	3	-
Ndumfri	175	59	65	41	12	1
Subri	965	544	247	156	51	7
Fure	381	78	99	74	49	11

SEEDLING. Germination is epigeal. The hypocotyl is 3-5 in. long, sturdy and woody. The cotyledons enlarge to become broadly elliptic, about 2 in. long and 1½ in. broad, rounded, very slightly cordate, distinctly veined, dark green above and with golden stellate hairs below, and with short, stout petioles. The primary leaves are alternate, stipulate, and whether they are simple or compound seems to depend on the amount of light reaching them. It is not unusual for a compound leaf to be followed by a simple one if light conditions worsen over the seedling. The simple leaf is elliptic, about 3½ in. long and 1½ in. broad, entire, acuminate, cuneate, dark green above and golden stellate below, and with a petiole about 1 in. long. The first of the compound leaves are bi- or tri-foliate, and later ones are digitate with 5 or 7 leaflets. Their formation is delayed in shady conditions.

NATURAL REGENERATION. Often this is found in groups, especially where the canopy has been disturbed but not entirely removed. If light conditions are suitable, then growth is rapid. The following height records of natural seedlings are taken from an area of the Subri F.R. which is being treated experimentally under the Tropical Shelterwood System:

1st. year	2nd. year	3rd. year	4th. year
11 in.	15 in.	32 in.	45 in.
15	16	25	52
26	38	58	84
14	30	36	62

ARTIFICIAL REGENERATION. There are about 34 winged fruits to an ounce. The germination period is about 11 days. Germination is usually speedy, and with fresh seed the germination percent is about 85. Growth in the nursery is somewhat erratic, and at the end of the 1st. year the seedlings may be 9 in. to 3 ft. high,

with an average of 1 ft. 4 in. According to the data obtained to date (1952), it appears better to leave the seedlings in the nursery bed until they are 2 years old. It seems immaterial whether they are grown under raphia screens or in the open. 5 ft. high striplings have been planted out in the Subri F.R. under high shade, and the establishment has been successful.

8. TRIPLOCHITON K.Schum.

Triplochiton scleroxylon K.Schum.

SYNONYMS. T. johnsonii C.H.Wright T. nigericum Sprague

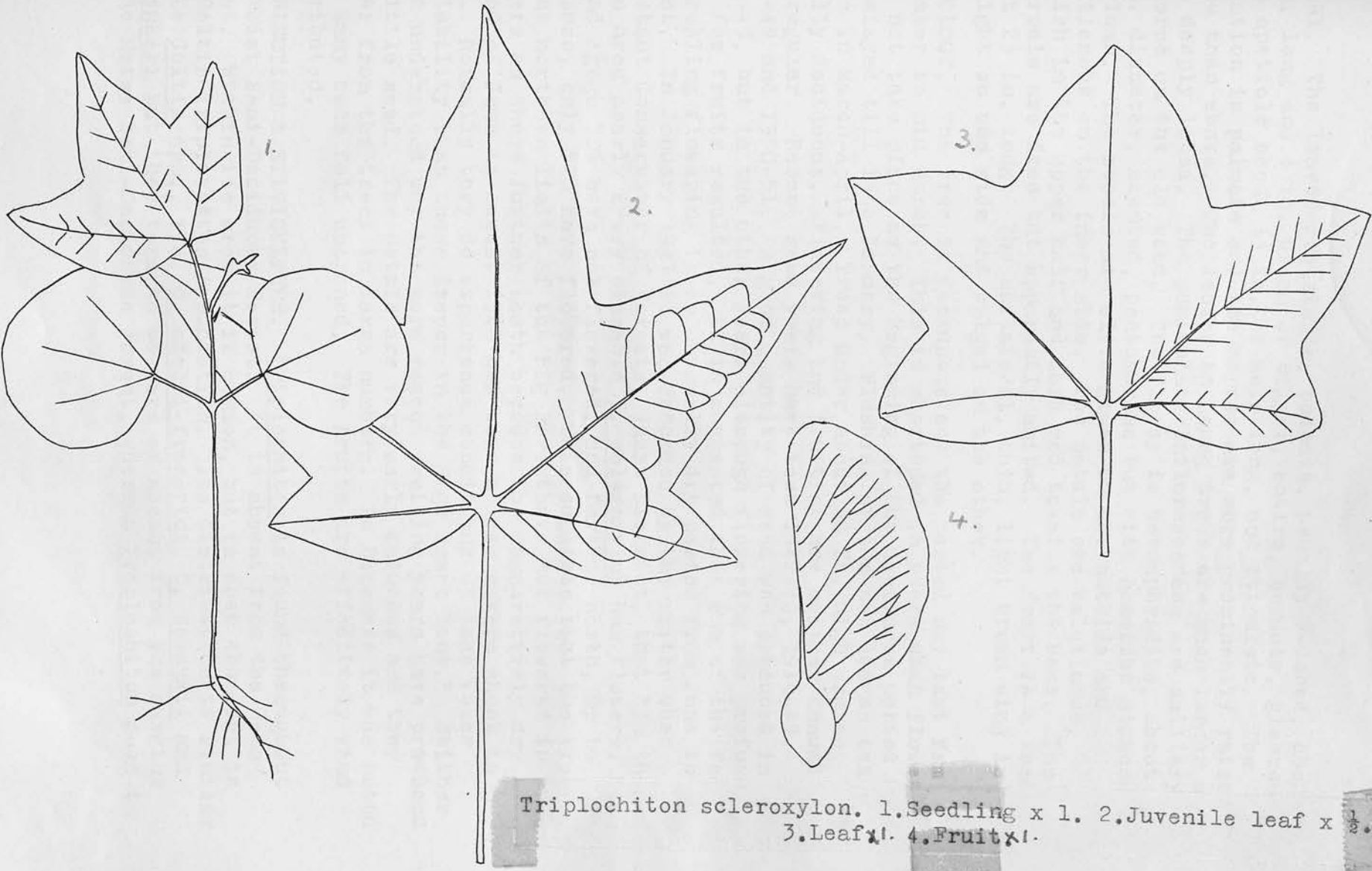
VERNACULAR NAMES. Pataboa (S). Wawa (Ao,Ash,F,T,W).

TRADE NAME. Obeche.

An emergent tree of the Moist Semi-Deciduous Forest. The following records are taken from trees felled for exploitation:

Girth above buttresses	Length of bole	Height	Volume over bark
11 ft. 10 in.	119 ft. 4 in.	178 ft.10 in.	1,032 cu. ft.
14 2	95 8	181 6	1,093
15 2	93 10	179 2	1,508
16 0	82 7	173 4	1,337
16 7	79 10	179 11	1,186

The tall bole is straight but not always cylindrical, especially when grown under unsuitable conditions. In such circumstances it may be mis-shapen by fluting and bending. Occasionally almost rectangular stems are seen. The narrow buttresses may be 12 ft. high or more. The crown of the tree in the pole stage is conical and close. In the mature tree, it is rounded and wide. The bark of young trees is grey, smooth and with numerous lenticels, but in older ones there are light grey, dry, thin, irregular scales. The outer slash is dark brown, and the inner thick, light yellow-brown and fibrous. The heart is white to pale yellow, hardly different from the sapwood in colour, 24 lb. per cu. ft. at 15% moisture content, soft (the specific name meaning hard wood is a misnomer), with an interlocked grain but easily worked. The wood has a disagreeable odour when fresh but loses it on drying. It is very susceptible to insect attack and fungal stain when wet. The small vessels and the numerous medullary rays are barely visible but can be seen with a hand lens. The wood is put to many uses where lightness combined with reasonable strength are required. It is suitable for boxes, packing cases, shuttering, pattern making, light carpentry and cheap plywood. The buttresses are cut for platters. This is the principal wood from which sea canoes are made. They are hewn out in the forest and transported by road or rail to the coast.



Triplochiton scleroxylon. 1.Seedling x 1. 2.Juvenile leaf x ½.
3.Leaf x 1. 4.Fruit x 1.

BOTANY. The leaves are simple, palmate, usually 5-lobed, about 3 in. long and 4 in. broad or bigger, entire, cordate, glabrous, with apetiole about 1½ in. or more long, and stipulate. The nervation is palmate and the nerves are more prominently raised below than above. The leaves on young trees are much larger and more deeply lobed. The paniculate inflorescences are axillary or borne on the old wood. The flower is hermaphrodite, about 1 in. diameter, scented, pentamerous but with numerous stamens in a column. The sepals are olive green on the outside and velutionous on the inner side. The petals are velutinous, pinkish in the upper half and dark red towards the base. The 5 carpels are free but apparently united. The fruit is a samara, about 2½ in. long. The unilateral, thin, light brown wing is straight on one side and bulged on the other.

PHENOLOGY. The tree is deciduous and the period may last frm December to mid March. This is shortened in years when flowering does not take place as the beginning of the deciduous period may be delayed till late January. Flushing of the new leaves takes place in March-April. Trees under about 30 ft. high are not usually deciduous. Flowering and fruiting are neither annual nor regular. Recent seed years have been 1942-43, 1946-47, 1948-49 and 1950-51. A good quantity of seed was produced in 1942-43, but in the other years although flowering was profuse, very few fruits resulted. It is suggested that one of the factors controlling flowering is an unusually dry period from June to August. In January 1947 it was recorded by the writer when Assistant Conservator of Forests, Juaso District, that "In the Juaso area nearly every sizeable T. scleroxylon has flowers. Around Agogo 20% have not flowered, and further north, up to Drabonso, only 50% have flowered. This suggests that the trees in the northern limits of the Hig Foresthave not flowered in such numbers as those further south because the comparatively dry period of June to August 1946 had been a less severe shock to them. Normally they do experience conditions of less water availability than those deeper in the High Foest Zone." Neither is it understood why the more recent fruiting years have produced so little seed. The petals are very early caducous and they shower from the trees in large numbers. In December it was noted that many buds fell unopened. The fruits are effectively wind distributed.

DISTRIBUTION & SILVICULTURE. Triplochiton is found throughout the Moist Semi-Deciduous Forest. It is absent from the Rain Forest. Within its area it is common, but is most abundant in the Celtis-Triplochiton Association. Its distribution is similar to the Celtis spp., i.e. C. adolfi-frederici, C. soyauxii and C. zenkeri but they tend to be rare or absent from the margins of the Moist Semi-Deciduous Forest, whereas Triplochiton goes to

1.

2.

3.

4.

Triplochiton scleroxylon. 1.Young tree. 2.Tree.
3.Bole. 4.Badly shaped bole.

the limits of this type. It also extends into the Riverain Forest of the southern Savannah-Woodland.

Triplochiton is a light demander, and although it may persist in shady conditions in the seedling stage, it is really stagnating in such conditions and does not recover properly. Unless it gets a sufficient amount of overhead light, it tends to become misshapen, owing to the loss of succeeding terminal shoots when a lateral shoot attempts to grow towards the light source. This, no doubt, is the cause of some of the monstrosities seen in the forest, which have had a struggle to get to the light. This species is a coloniser, capable of rapid growth, and it is a constituent of Secondary Forest. The best stems seem to result from quick growing trees such as those which have grown up in gaps in the forest and in Secondary Forest. This species appears to reach economic maturity when about 9-11 ft. girth above buttresses. After this it is not unusual to find the heart spongy. This condition may also be a locality factor. Triplochiton is adaptable to various soils, but it avoids swampy conditions. The root system is shallower than most of its associates, and it is not uncommon to find the tree windblown, especially on wet or shallow soils.

The following frequency figures are taken from enumeration surveys:

		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11+
Kakum	508	89	95	133	120	81
Oda River	436	261	174	187	143	173
Asenanyo	77	50	40	28	14	18
Bobiri	94	74	60	47	28	93
Ayum	306	218	223	253	155	51
Afram Headwaters	185	201	180	135	68	51

SEEDLING. Germination is epigeal. The hypocotyl is slender and about 2 in. long. The cotyledons are almost orbicular, about 1 in. long and 1½ in. broad, 3-5 veined from the base and with slender petioles about 0.4 in. long. The primary leaves are alternate, simple, palmate. The first leaf is borne about ¾ in. above the cotyledons, and is trilobed, about 1½ in. long and 2 in. broad, palmately nerved and glabrous except for a few hairs on the nerves on the underside. The petiole is slender, ½ in. long and slightly pubescent. The twin acicular stipules are up to about 0.4 in. long and caducous. The stem is green and slightly pubescent. Later leaves are 5-lobed. The lobes are sometimes very deep on seedling and sapling plants.

NATURAL REGENERATION. Following a good seed year, young seedlings are to be found where light conditions are suitable for this species. It colonises rapidly, and groups of even aged poles are not uncommon in Secondary Forest. The leading shoot is easily killed by lack of light, and this may be brought about by smothering climbers. Recovery is often made by a lateral shoot. Branches are robust in the sapling, and a deep crown is formed in the pole stage, but large branches are not usual till they are developed in the crown of the tree when it is at its maximum height. The rapid growth of the young plant is shown in the following measurements of natural regeneration in Tropical Shelterwood System plots:

1st. year	2nd. year	3rd. year	4th. year
9 in.	37 in.	46 in.	69 in.
17	45	69	86
16	51	78	100
23	59	97	138
21	43	89	117
14	87	94	106

ARTIFICIAL REGENERATION. There are about 84 winged fruits (1 seeded) to an ounce. The germination period is 6-15 days and the germination percent about 55. Stock cannot be kept for more than a year in the nursery for growth is very fast. Heights of 6 ft. have been recorded at 6 months and 10 ft. in a year. At 15 months many of the plants may be between 7-12 ft. high. In the Bobiri F.R. nursery, the tallest plants at 15 months were 15 ft. high. Stumped plants have given good results in taungya plantations, but unless the soil is moist at the time of planting, the stumps are liable to suffer severely and then be attacked by termites and perhaps fatally damaged. Because of its rapid growth and large crown, Triplochiton must be grown in pure groups in plantations. Almost any indigenous species, except Terminalia ivorensis and T. superba, when grown in intimate mixture with it is likely to be suppressed. This lesson can be learnt from several taungya plantations in the Gold Coast. In the 1948 Taungya in the Pra-Anum F.R., the stump planted Triplochiton had reached a height of 24 ft. and 19 in. G.B.H in 1951. The original planting distance was 10 ft. X 10 fr. In 3 years the canopy was closed and effective enough to dispense with a cleaning operation. In the following year some of the Triplochiton were 33 ft. high and 1 ft. 10½ in. G.B.H., with a live crown 12 ft. deep.

In view of the irregular seed years and the uncertain quantity of seed that may be produced, this species cannot be relied upon for supplying plantation requirements.

PATHOLOGY. There is abundant starch in the sapwood and so it is not surprising that it is readily attacked by beetles of the Bostrychidae and Lyctidae - the powder post beetles. Bostrychoplites cornutus Oliv. and Apate tenebrans Pallas and Heterobostrychus brunneus Murr. have been identified on Triphochiton sapwood.

The leading shoots of seedlings and saplings are liable to be killed by aphids.

Almost annually, in August-September, much defoliation by the caterpillar of Anaphe venata may take place. The following is a precis of a note on Anaphe venata written by A.E.Storrs, A.C.F.

The eggs are laid by the moth on tall Triplochiton trees in May. The caterpillars emerge in 3 weeks and they eat the leaves - often stripping the tree. The caterpillars are brown snd hairy, and arefully grown in August. They then descend to the ground and fan out in line from the tree to the undersides of the leaves of shrubs and low trees. There communal light brown cocoons are formed, but containing individual cocoons. The pupation period is about 7-8 months. In April the adults emerge. Mating takes place almost immediately and the eggs are laid on the Triplochiton trees.

Defoliation may be more severe in some localities than in others during a particular year. Although this loss of leaves takes place, new ones are soon produced, and whatever may be the loss in increment, it is not apparent.

ULMACEAE.

A family of trees with 2-ranked, stipulate, often asymmetrical leaves, and apetalous, small, often unisexual flowers. The ovary is superior and usually unilocular. The fruit is generally a drupe or samara.

Chaetacme microcarpa Rendle is a shrub to small tree armed with axillary spines; it is found in the Savannah-Woodland and Coastal Scrub and Grassland.

GENERA. 1. Celtis L. 2. Holoptelea Planch. 3. Trema Lour.

1. CELTIS L.

Besides the species described below, there is C. integrifolia Lamk., a tree of the Riverain Woodland.

SPECIES. (i) C. adolfi-frederici Engl. (ii) C. scotellioides A.Chev. (iii) C. soyauxii Engl. (iv) C. zenkeri Engl.

(i) Celtis adolfi-frederici Engl.

SYNONYM. C. fragifera A.Chev.

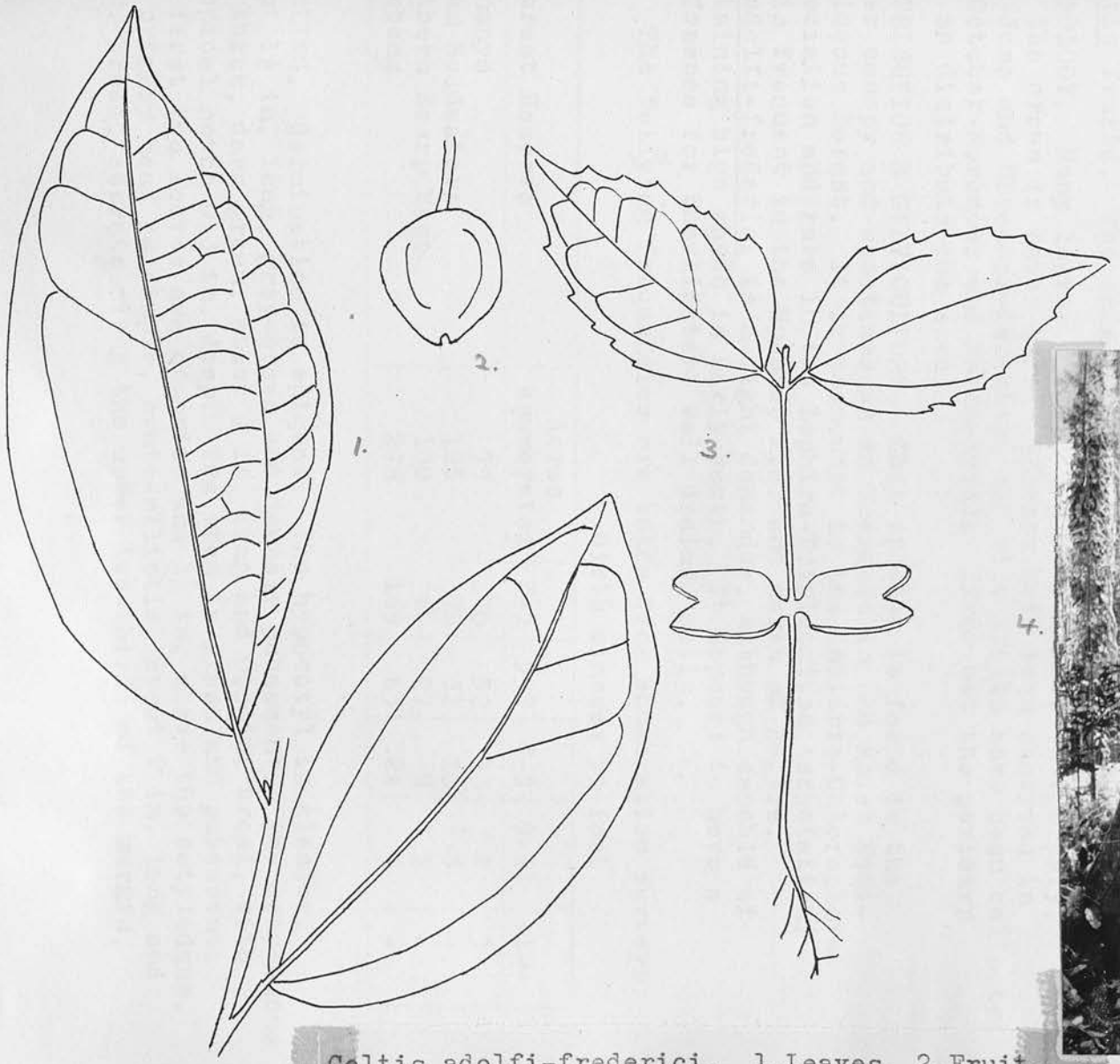
VERNACULAR NAMES. Esa-biri (Ao,S). Esa-kokobin (S). Esa-kosua (Ash,T). Esa-pie (Ash). Fusa (T).

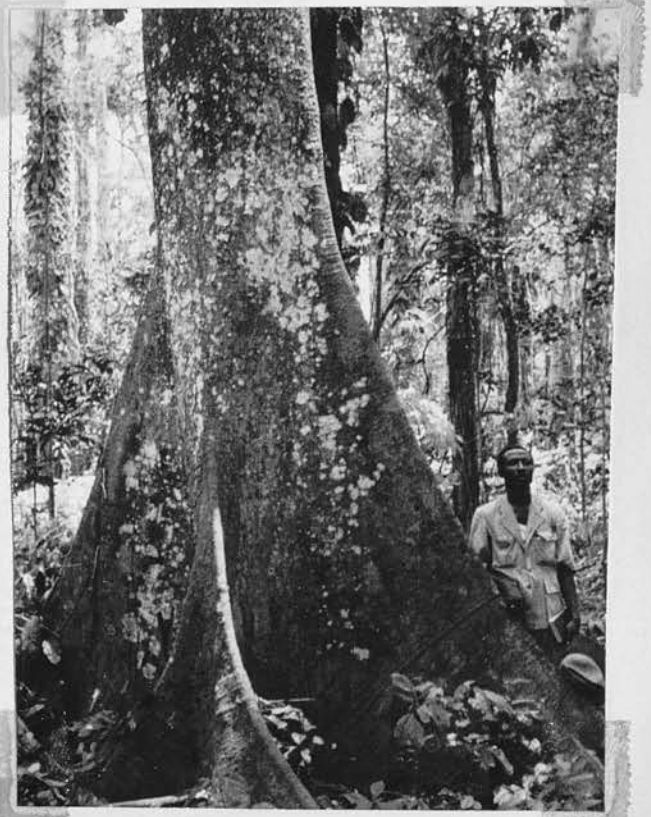
Esa is applied to the genus Celtis. Biri (black) is on account of the dark bark. Kokobin (red - brown) refers to the dark marks in the slash. Kosua (egg) refers to the shape of the leaf.

A tall tree of the High Forest. The following measurements are of felled trees:

Girth above buttresses	Length of bole	Height of tree.
7 ft. 1 in.	104 ft. 3 in.	149 ft. 0 in.
7 3	93 9	153 9
8 6	80 9	154 9
9 3	114 7	150 7
10 4	113 0	167 0

The bole is slender and the buttresses are narrow and high. The crown is rounded, and darker and larger than that of C. soyauxii. But it is not deep. The branches are horizontal and drooping at the ends. The bark is dark grey, rough and often with horizontal ridges. The slash is light brown, very granular, making a gritty sound when cut, and containing very many dark brown to almost black concentric lines. The wood is white and moderately heavy. In transverse section, the numerous scattered





Celtis adolfi-frederici. 1.Leaves. 2.Fruit.
3.Seedling. All x 1. 4. Bole.

vessels are only barely visible. With a hand lens the very fine medullary rays can be seen and also the parenchyma joining into short and long transverse bands. The tree provides a good firewood and the young poles are used as fufu pestles and for the framework of native mud houses.

BOTANY. The leaves are alternate and stipulate. The leaf is broadly elliptic, about 4 in. long and 2¼ in. broad, asymmetrical, entire, acuminate, unequal sided at the base, glabrous, shiny, smooth above and scabrid below. The petiole is 0.4 in. long and channelled above. The leaf is trinerved from the base - the two lateral nerves reaching to near the apex. The veins are faint and irregularly parallel. The small, white, unisexual flowers are in profuse axillary panicles. The fruit is a subglobose drupe, about ¾ in. long - the largest of the High Forest Celtis fruits. The endocarp is white, very hard and pitted.

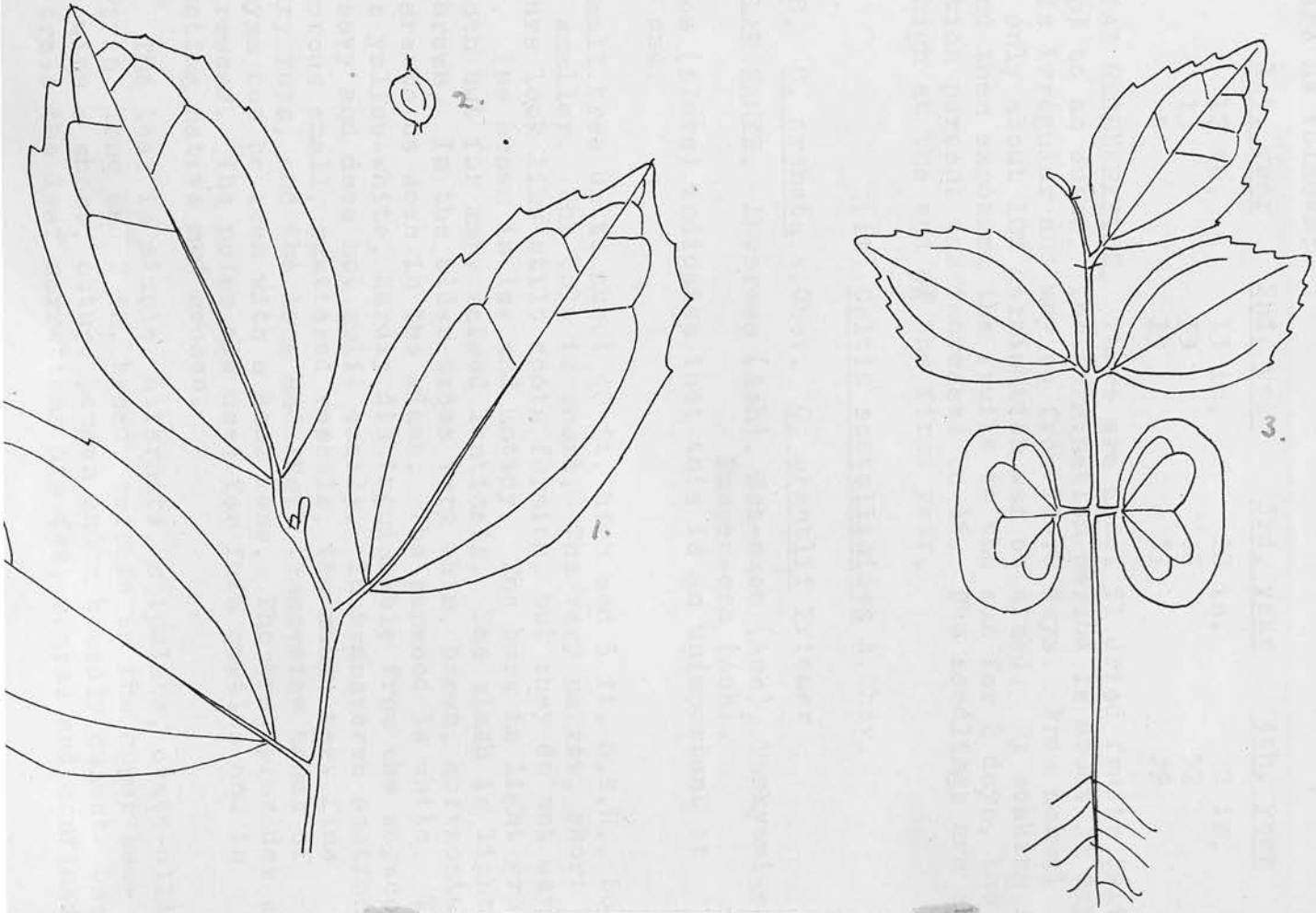
PHENOLOGY. Many leaves are dropped in December to February, but the crown is never bare. Flowers have been observed in May-June and November-December, and ripe fruits have been collected in October-November and March-April. Birds eat the pericarp and so distribute the seed.

DISTRIBUTION & SILVICULTURE. This species is found in the upper canopy and sometimes as an emergent in the Moist Semi-Deciduous Forest. It is commonest in the Antiaris-Chlorophora Association and rare in the Lophira-Triplochiton Association. It is frequent in the Mpameso F.R. and north of Begoro. C. adolfi-frederici is a light demander, although capable of sustaining high shade in early youth. It appears to have a preference for the lighter, well drained soils.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet 3-5	5-7	7-9	9-11	11+
Asenanyo	77	70	50	13	2	3
Afram Headwaters	185	78	31	10	3	-
Northern Saarp East	100	60	27	8	1	-
Worobong	278	169	63	24	4	-

SEEDLING. Germination is epigeal. The hypocotyl is slender, about 1½ in. long, grey-brown and densely pubescent. The cotyledons are thick, dark green, about ¾ in. long and 0.3 in. broad, with an apical notch 0.3 in. deep. The stem is green and pubescent. The first two leaves are opposite and 1½ in. above the cotyledons. The primary leaf is simple, ovate-elliptic, about 2 in. long and 1 in. broad, serrate along the upper two-thirds of the margin,



Celtis scotellioides. 1.Leaves.
2.Fruit. 3.Seedling. All x 1.

acuminate, rounded at the base, with a short petiole and small stipules. The leaf is trinerved from the base and the undersides of the nerves are green and finely pubescent. The succeeding leaves are alternate.

NATURAL REGENERATION. This is most plentiful in April. The sapling has a different habit from that of C. zenkeri and especially C. soyauxii in being erect. It is conspicuous too, on account of its thick, dark green leaves. Rates of growth of seedlings in regeneration plots of the Tropical Shelterwood System are as follows:

1st. year	2nd. year	3rd. year	4th. year
12 in.	13 in.	18 in.	22 in.
13	39	46	52
6	19	31	39

ARTIFICIAL REGENERATION. There are about 51 dried fruits (without pericarp) to an ounce. The germination period is about 33 days, but it is irregular and may be from 18-48 days. From normal sowings only about 10% germination was obtained. By soaking in water and then exposing the fruits to the sun for 2 days, the germination percent was increased to 15. The seedlings are about 20 in. high at the end of the first year.

(ii) Celtis scotellioides A.Chev.

SYNONYMS. C. crenata A.Chev. C. prantlii Priemer

VERNACULAR NAMES. Ahwerewa (Ash). Esa-akoa (Ash). Pankyani-esa (S). Pempen-esa (Ash).

Akoa (slave) indicates that this is an unimportant or useless esa.

A small tree up to about 40 ft. high and 5 ft. G.B.H., but usually smaller. The bole is short. The very narrow, short root spurs look like stilt roots forming, but they do not develop further. The crown is low and untidy. The bark is light grey and smooth but for many raised lenticels. The slash is light yellow-brown. In the older trees very thin, brown, horizontal flecks are to be seen in the slash. The sapwood is white. The heart is yellow-white, hardly distinguishable from the sapwood, hard, heavy and does not split easily. In transverse section, the numerous small, scattered vessels, the many, very fine medullary rays, and the long and short transverse bands of parenchyma can be seen with a hand lens. The tree provides a good firewood. The poles are used for fufu pestles and in constructing native mud houses.

BOTANY. The leaf is simple, alternate, stipulate, ovate-elliptic, about 3½ in. long and 2 in. broad, serrate in the upper two-thirds, with a short, obtuse acumen and a broadly cuneate base. In old trees the leaf serrations are few, coarse and confined

to the apical one-third. The leaf is coriaceous and glabrous. The petiole is about 0.3 in. long and channelled above. The leaf is trinerved from the base - the two lateral nerves being longer than half the length of the leaf. The midrib and nerves are conspicuous below and the nerves are looped. The stipules are caducous early. The minute white flowers are in axillary clusters. The fruit is an ovoid red drupe, about 0.3 in. long, ribbed and with a pedicel about the same length. The endocarp is hard and ribbed.

PHENOLOGY. The tree is evergreen. Flowers have been observed in October to December and March to June, and ripe fruits have been collected in March to May and mid September to October.

DISTRIBUTION & SILVICULTURE. This species belongs to the understorey of the Moist Semi-Deciduous Forest. Locally it may be common and sometimes it is semi-gregarious.

SEDDLING. Germination is epigeal. The hypocotyl is about 1½ in. long, slender, woody, pubescent and straw coloured. The cotyledons expand to become oblong, anout 0.6 in. long and 1.2 in. broad, thin, green, veined and with short petioles about 0.15 in. long. The cotyledons are very early caducous - they are dropped before the 3rd. primary leaf is formed. The first two leaves are simple, opposite, and about ¾ in. above the cotyledons. The succeeding leaves are alternate. The 3rd. leaf is elliptic, about 1½ in. long and ¾ in. broad, deeply serrate on the apical two-thirds, bluntly acuminate, almost rounded at the base and with a short petiole. The leaf is trinerved from the base - the two lateral nerves being longer than half the length of the lamina. The paired stipules are acicular and small.

NATURAL REGENERATION. Much regeneration can be seen in April, but usually under or near the mother trees.

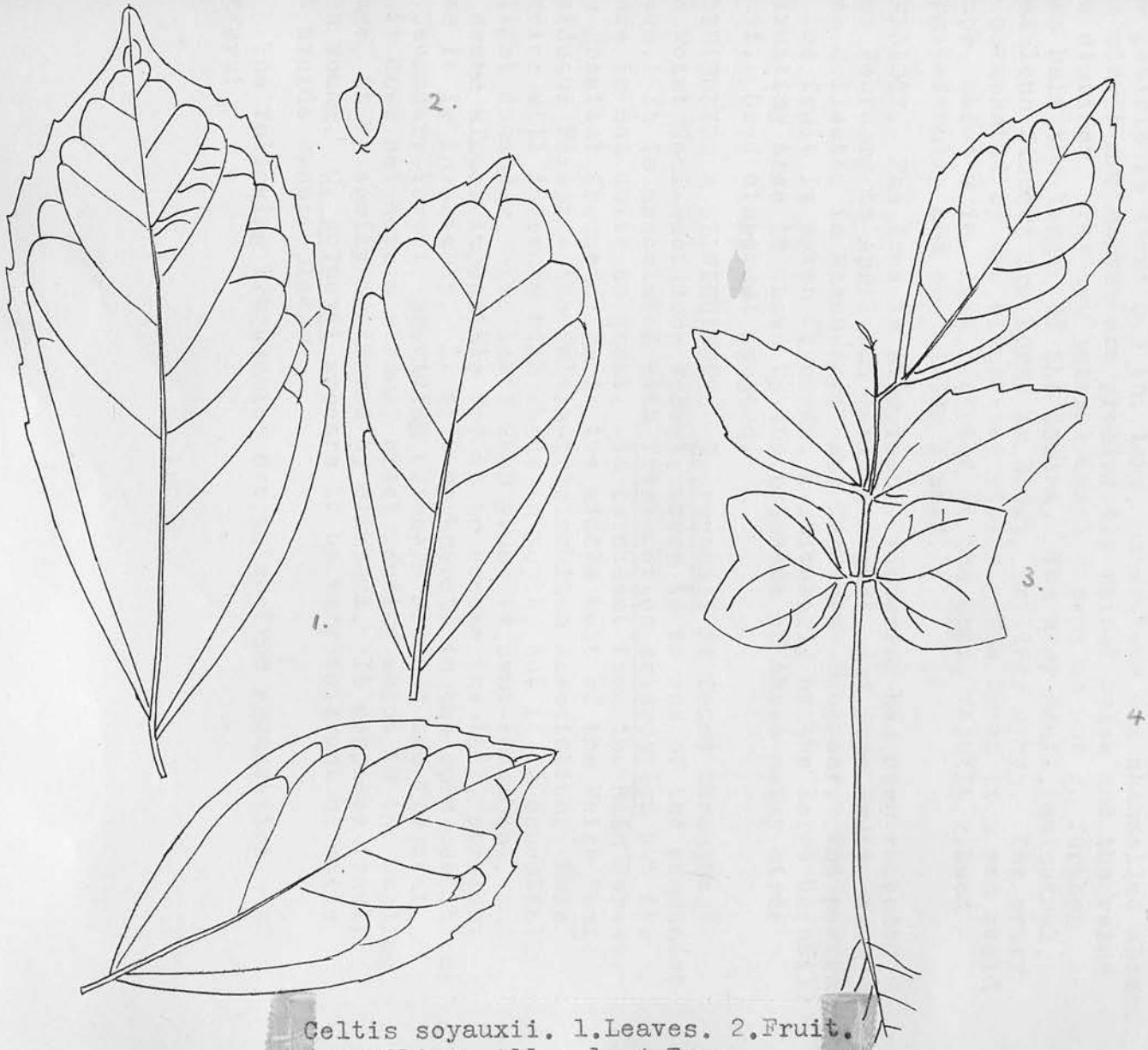
(iii) Celtis soyauxii Engl.

SYNONYM. C. compressa A.Chev.

VERNACULAR NAMES. Esa (Ash,T,W). Esa-pa (Ash).
The reason for the suffix pa (good) is that this is considered the best esa.

TRADE NAME. Celtis.

A tall tree, reaching about 180 ft. high and with a girth above buttresses of up to 9 ft., but often less. The bole is long, slender, cylindrical and straight. The narrow buttresses may be 9 ft. high. The crown is characteristically small, globose and composed of horizontal, thin branches. The bark is thin, light grey and peeling off in thin scales. The slash is light yellow-brown with regular brown concentric lines in it.



Celtis soyauxii. 1.Leaves. 2.Fruit.
3.Seedling. All x 1. 4.Tree.

The wood is light yellow to white, with no difference between sapwood and heart, 45-50 lb. per cu. ft. at 15% moisture content, dense, moderately fine texture, uniform and splits easily. It is not resistant to decay and stains quickly if kept under damp conditions. This species provides one of the best firewoods. Poles are used as fufu pestles and in the framework of mud houses.

BOTANY. The leaves are simple, alternate, stipulate. The leaf is elliptic-ovate to ovate, about 3½ in. long and 1½ in. broad, serrate in the upper two-thirds, but almost entire on the older trees, broadly acuminate, sometimes unequal sided at the base and either broadly cuneate or rounded, coriaceous and glabrous. The petiole is about 0.3 in. long, puberulous and channelled above. The midrib and nerves are prominently raised below and the veins are distinct. The two lateral basal nerves do not go further than half the length of the lamina. The very small, unisexual, apetalous flowers are borne in short, axillary cymes. The ovary is surmounted by two bifurcated styles. The fruit is a red ovoid drupe, about ½ in. long, pointed at the apex, faintly ribbed longitudinally and containing 1 seed.

PHENOLOGY. The tree is evergreen. Flowering has been recorded from February to April and June to August, and ripe fruits have been collected in March-April and September-December. The pericarp of the fruit is eaten by birds, particularly by the large hornbills; a fruiting tree is known by the presence of these noisy birds on it. Seed dispersal is good.

DISTRIBUTION & SILVICULTURE. C. soyauxii is found throughout the Moist Semi-Deciduous Forest, where it is one of the commonest trees. It is associated with Triplochiton scleroxylon but its range is not quite as great. It is absent from the Rain Forest. Its greatest frequency is in the middle belt of the Moist Semi-Deciduous Forest - the Celtis-Triplochiton Association. This species will tolerate high shade in youth, but it is essentially a light demander. Its habit wnen young is semi-recumbent, and it seems almost impossible for it to become the tall, straight tree it is invariably. It will regenerate in the open conditions of Secondary Forest, providing climbers are not too frequent. As it does not have a strong, erect leading shoot in the sapling stage, it is easily smothered by climbers. It coppices freely when young. C. soyauxii appears to be very tolerant of soils but avoids swampy places.

The following frequencies are taken from enumeration surveys:

Forest Reserve	Acres enumerated	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Onuem-Nyamibe Shelterbelt	62	295	74	29	13	4
Asenanyo	96	235	77	12	2	-
Afram Headwaters	185	342	49	9	-	-
Northern Scarp East	100	274	69	17	2	-

SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long, straw coloured and distinctly pubescent. The cotyledons develop to become almost rectangular, about 0.8 in. long and 1 in. broad, with a wide shallow notch at the apex, rounded at the base, veined and with a short petiole about 0.1 in. long. The first two leaves are borne about $\frac{1}{2}$ in. above the cotyledons and are opposite. The remaining leaves are alternate, simple and stipulate. The 3rd. leaf is obovate-elliptic, about $2\frac{1}{2}$ in. long and $1\frac{1}{4}$ in. broad, coarsely serrate in the upper half, broadly acuminate and mucronate, cuneate at the base, trinerved from the base, with the lateral nerves not longer than half the length of the lamina. The undersides of the nerves are brown and pubescent. The petiole is about 0.2 in. long. The twin acicular stipules are small and straw coloured. The shoot, petioles and stipules are slightly pubescent and the leaf margin is ciliate.

NATURAL REGENERATION. This is plentiful throughout the Moist Semi-Deciduous Forest, particularly in open and partially open places. The cotyledonary stage of the seedling is most noticeable in April. Where the light is insufficient, growth may be slow, but once established, the sapling is capable of rapid growth. The following records of seedling heights are taken from Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
7 in.	15 in.	24 in.	36 in.
9	20	26	43
11	19	56	70
12	23	45	53
6	18	30	45
11	27	51	102

ARTIFICIAL REGENERATION. There are about 57 dried fruits (no pericarp) to an ounce.

(iv) Celtis zenkeri Engl.

SYNONYM. C. rugosa A.Chev.

VERNACULAR NAME. Esa-kokoo (Ash,T). Kokoo means red, and it is uncertain whether this refers to the brown markings in the slash or to the red drupe.

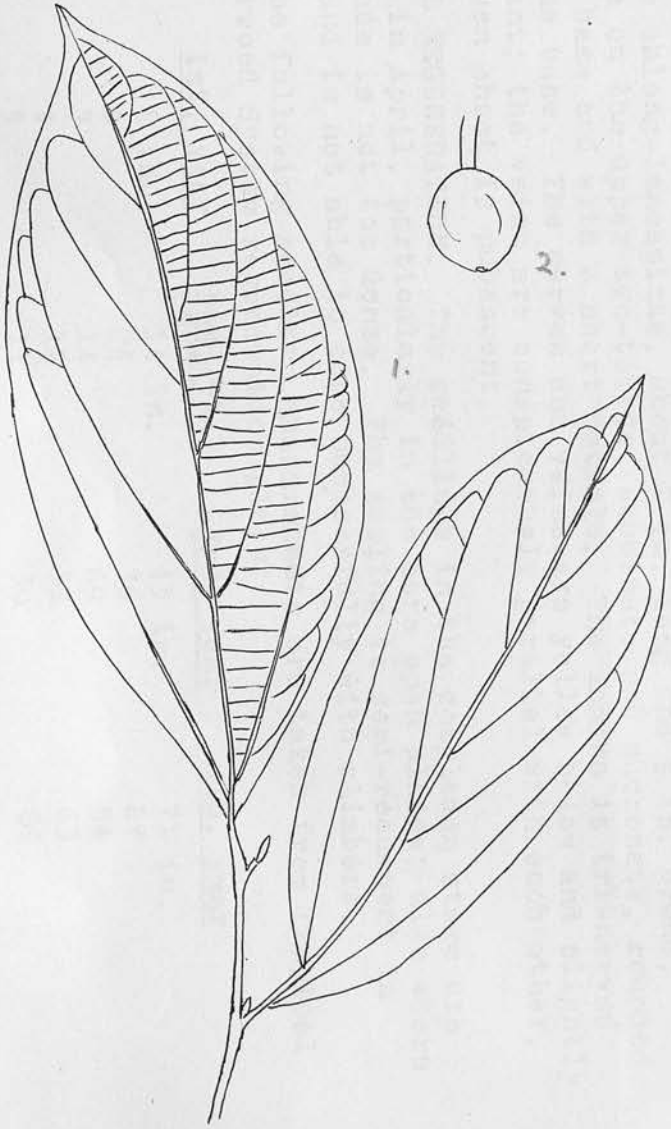
A tall tree but seldom exceeding 9 ft. girth above buttresses. The following measurements are of felled trees:

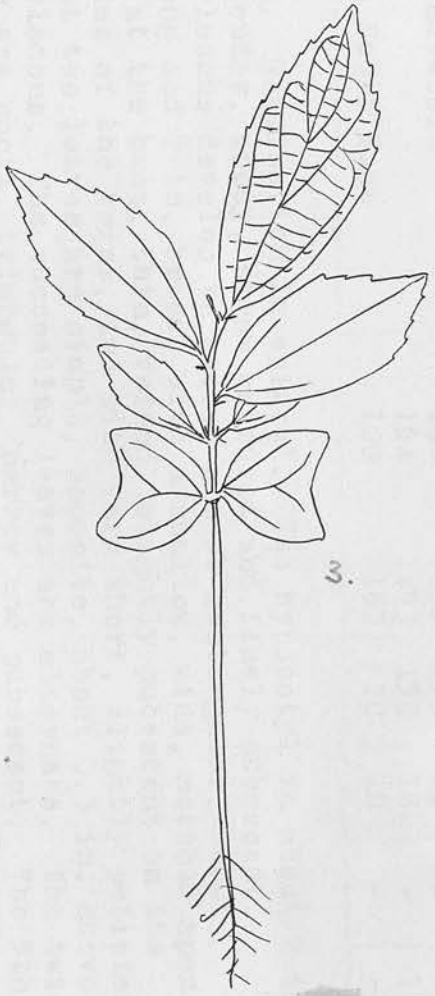
Girth above buttresses	Length of bole	Height of tree
8 ft. 10 in.	104 ft. 6 in.	170 ft. 4 in.
9 0	124 1	166 3
9 10	85 2	155 5
13 9	76 2	166 10

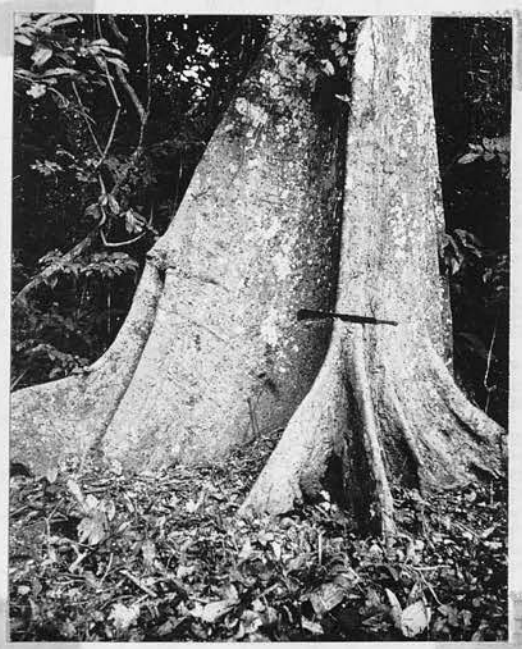
The stem is straight and slender. The buttresses are narrow, up to 10 ft. high and often appear more as fluting. The crown is rounded but more spreding than that of C. soyauxii. The bark is tin, dark grey and irregularly flaky. The slash is light yellow-brown, and contains light brown concentric rings - lighter and broader than those of C. soyauxii. The wood is light yellow and without any differentiation between heart and sapwood. The tree supplies a good firewood and the poles are used for fufu pestles and the framework of native mud huts.

BOTANY. The leaf is elliptic, about 5 in. long and 2 in. broad, entire (serrate in juvenile plants), acuminate, cuneate to almost rounded at the base and with unequal sides and yellow-brown or red-brown pubescent below. The petiole is about 0.2 in. long. The midrib, nerves and veins are conspicuously parallel with each other. There are two lateral basal nerves. The other nerves are set acutely to the midrib. The stipules are caducous and rusty coloured. The leaf is more flexible than that of C. soyauxii. The very small, unisexual, apetalous flowers are borne in short, axillary panicles. The fruit is a globose, red drupe, about ½ in. long, and the endocarp has a rough surface.

PHENOLOGY. This species may be deciduous, especially towards its northern limits. Leaf shedding begins in November, but it is usually only in February that leafless trees are to be found. Often the flushing of the new, light green leaves takes place before the last of the old ones have been dropped. As with the other species of tall Celtis, it is not easy to know when a tree is flowering as the minute flowers are not perceptible from the ground. Flowers have been observed in March and August-September, and ripe fruits have been collected in March-April and September-November. The seeds are bird distributed.







Celtis zenkeri. 1.Leaves. 2.Fruit.
3.Seedling. All x 1. 4.Bole.

DISTRIBUTION & SILVICULTURE. Although found throughout the Moist Semi-Deciduous Forest, C. zenkeri has its greatest frequency in the Antiaris-Chlorophora Association . It is frequent in such places as the Afram Headwaters and Mpameso F.Rs., and to the north of Begoro. It is also found in Togoland, as is to be expected, but it is surprising to find it fairly common in the Wiawso-Enchi area. This species also extends into the Riverain Forestof the southern Savannah-Woodland. This species is tolerant of a certain amount of shade in youth, but becomes a light demander. It is a constituent of the upper canopy and is not selective of any particular soils, but avoids swamps.

The following frequency figures are taken from enumeration surveys:

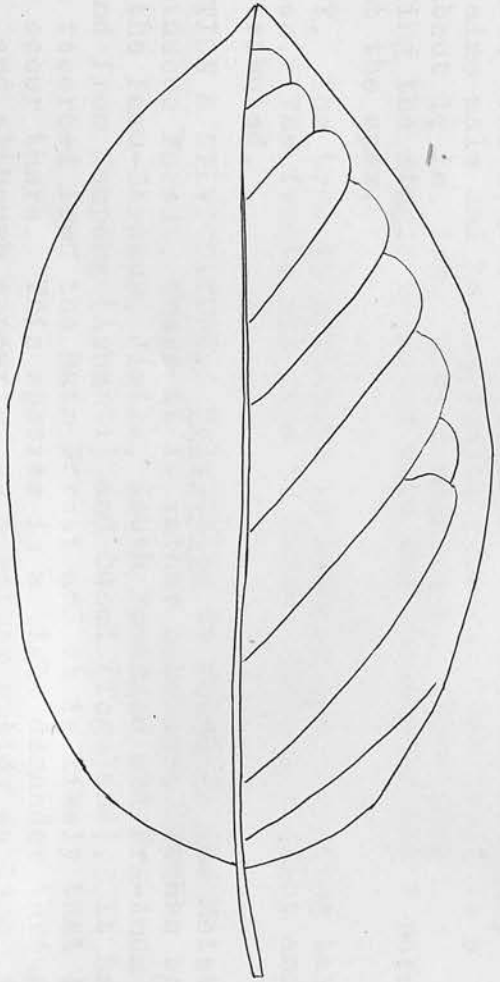
		Girth classes in feet.				
Forest Reserve	Acres enumerated	3-5	5-7	7-9	9-11	11-+
Afram Headwaters	185	295	153	69	12	-
Boumfum	154	453	153	18	-	1
Northern Scarp East	100	163	78	18	-	-

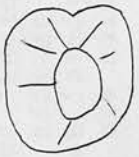
SEEDLING. Germination is epigeal. The hypocotyl is about 2 in. long, slender, woody, straw coloured and finely pubescent. The cotyledons develop to become almost rectangular, about ½ in. long and ¾ in. broad, with a shallow, wide, notched apex, rounded at the base, thin, veined, slightly pubescent on the undersides of the veins, and with very short, slightly petioles. The first two leaves are simple, opposite, about 0.3 in. above the cotyledons. The succeeding leaves are alternate. The twin stipules are short, triangular, narrow and pubescent. The 5th. leaf is oblong-lanceolate, about 2 in. long and ½ in. broad, serrate on the upper two-thirds, acuminate and mucronate, rounded at the base and with a short petiole. The lamina is tri-nerved from the base. The nerves and veins are yellow below and slightly pubescent; the veins are conspicuously parallel with each other. The green shoot is pubescent.

NATURAL REGENERATION. The seedlings in the cotyledon stage are common in April, particularly in the more open places; also where the shade is not too dense. The sapling is semi-recumbent in habit and is not able to cope successfully with climbers.

The following seedling measurements are taken from Tropical Shelterwood System regeneration plots:

1st. year	2nd. year	3rd. year	4th. year
6 in.	14 in.	43 in.	71 in.
6	24	36	67
7	14	69	84
4	12	32	63
5	11	30	82





Holoptelea grandis. 1.Leaf x 1.
2.Fruit x 1. 3.Bole. 4.Tree.

FIELD NOTES. This species is easily separated from the others by the characteristic venation.

2. HOLOPTELEA Planch.

Holoptelea grandis Mildbr.

SYNONYMS. H. integrifolia Rendle. Hymenocardia grandis Hutch.

VERNACULAR NAME. Onakwa (Ash,W).

A tree, 125 ft. high, or taller, with a girth not usually exceeding 10 ft. above the buttresses. The bole has the appearance of a not very well grown Triplochiton scleroxylon. It may be buttressed to 20 ft. high, and fluted right to the crown sometimes. The crown is rounded, not very dense nor large, and the leaves appear quite dark. The bark is light greyish-brown, irregularly scaly and resembling Triplochiton. The slash is light brown to brown, streaked with irregular darker brown lines, and sometimes with a thin, white inner layer. The sapwood is white, with a sheen, and containing very fine ripple marks. The heart is yellow, with a moderate sheen, fairly soft, about 40 lb. per cu. ft. at 12% moisture content, and with an interlocked grain. In transverse section, the fine, short bands of parenchyma are just visible. With a hand lens the numerous, fine medullary rays can be seen, and also the small vessels, fairly regularly distributed, each with a ring of parenchyma extending transversely as a narrow band. The ripple marks are obvious in longitudinal section.

BOTANY. The leaves are simple, alternate and with minute stipules. The leaf is elliptic, about 4½ in. long and 2½ in. broad, entire, acuminate, more or less rounded at the base and sometimes slightly asymmetric, glabrous, shiny green above and pale dull green below. The petiole is slender, about 0.4 in. long and channelled above. The midrib and nerves are raised below and the venation is reticulate. The cymose inflorescence is short and axillary and contains male and hermaphrodite flowers. The fruit is a samara about 1¼ in. long, with a membranous, white wing surrounding the single seed and with the remains of the 2 persistent styles at the apex.

PHENOLOGY. The tree is deciduous in January and flowering takes place then. The fruits are ripe in March. They are light and wind distributed.

DISTRIBUTION & SILVICULTURE. Holoptelea is found in the Moist Semi-Deciduous Forest, where it is rather uncommon. It has been seen in the Pamu-Berekum, Jimira, South Fomangsu and Pra-Anum F.Rs., and from Mampong (Ashanti) and Odomi (Togoland). It has not been recorded from the Rain Forest and it is likely that it does not occur there. This species is a light demander throughout its life, and although appearing as a rather untidy sapling, it

cleans itself readily of its side branches. It prefers fairly moist situations, but not swamps.

SEEDLING. Germination is epigeal. The hypocotyl is about 1 in. long and slightly pubescent. The cotyledons are petiolate and early caducous. The first two primary leaves are simple, opposite and about 1in. above the cotyledons. The succeeding leaves are alternate. The 3rd. leaf is elliptic, about 1 in. long and 0.6 in. broad, serrate in the upper half, acuminate, rounded at the base, slightly pubescent on the undersides of the nerves, and with a short, slender pubescent petiole. The stipules are small.

NATURAL REGENERATION. Although quite plentiful regeneration may be seen in April, much of it disappears soon because of sufficient light under normal closed forest conditions.

3. TREMA Lour.

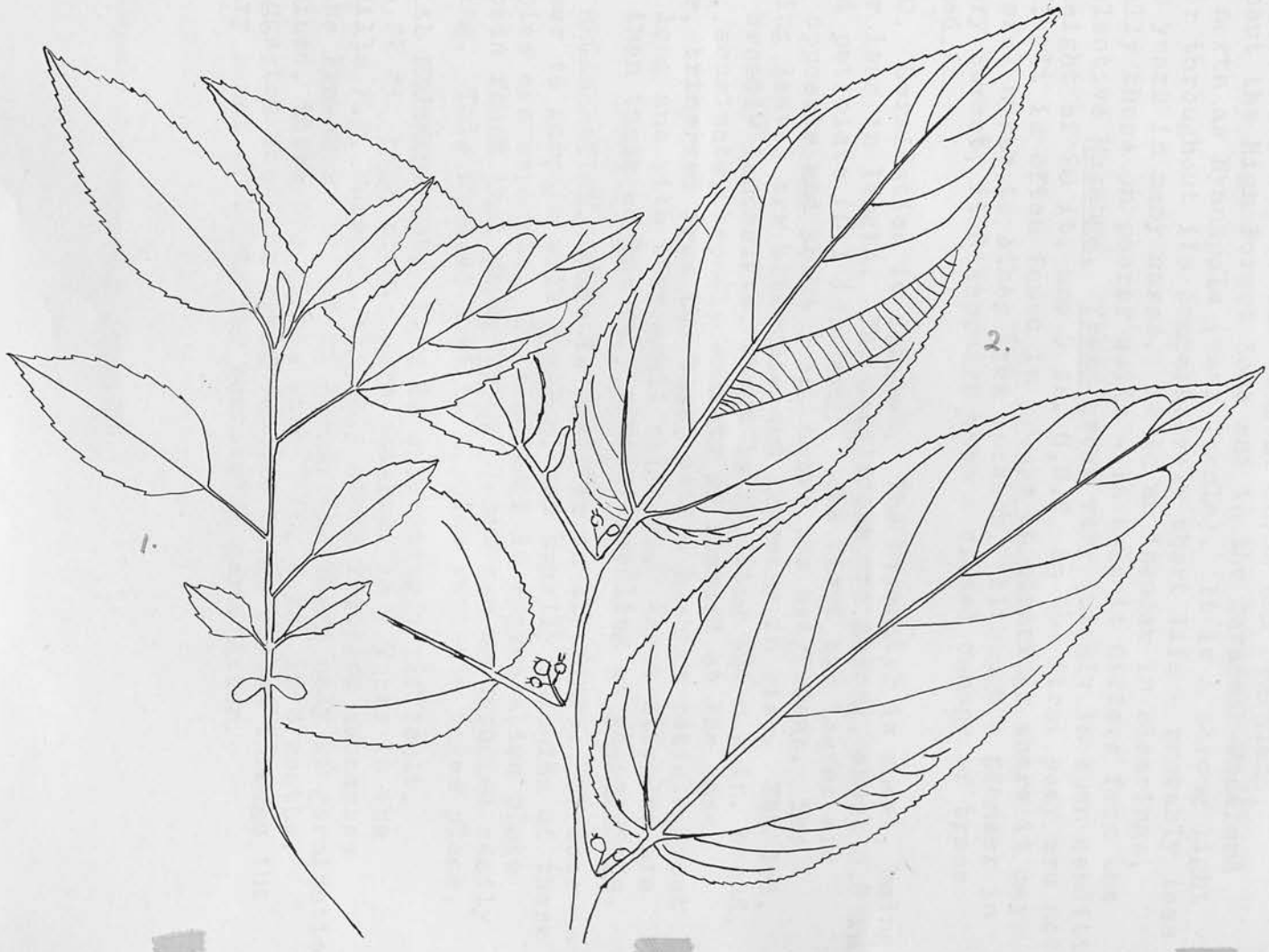
Trema guineensis Ficalho

SYNONYM. Celtis guineensis Schum.& Thonn.

VERNACULAR NAME. Sesea (Ash,F,T,W).

A small tree not often exceeding 25 ft. high and 3 ft. G.B.H. The stem is straight, very slender, brittle and easily broken. The crown is conical, often deep, and composed of thin, horizontal branches, but slightly ascending. The light grey, smooth bark is covered with many irregularly spaced lenticels. The slash is thin, bright green immediately below the bark and then a white layer which turns light brown on exposure. The wood is white and said to be durable and termite proof (14). It is used for rafters in native houses and has been satisfactorily employed as yokes for bullocks on the Department of Agriculture Farm at Mampong (Ashanti). The bark is used for string.

BOTANY. The leaves are simple, alternate, regularly 2-ranked, and the stipules are caducous. The leaf is ovate to broadly lanceolate, 4 in. to $2\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. to 1 in. broad (only $1\frac{1}{4}$ in. long and $\frac{1}{2}$ in. broad in Savannah-Woodland), finely serrate, acuminate, rounded, sub-cordate or cordate at the base, and with a slender green petiole about $\frac{1}{2}$ in. long and channelled above. The lamina is dull, dark green above, dull light green below and trimerved from the base. The midrib and nerves are raised below and are red. The veins are parallel with each other. The branchlets, petioles and leaves are covered with a white pubescence. The small flowers are in short axillary cymes. The fruit is a small, globose, black drupe, about 0.15 in. diameter, bearing the 2 persistent styles at the apex.



Trema guineensis. 1.Seedling. 2.Fruiting branchlet. Both x 1.

PHENOLOGY. The tree is evergreen. Flowering and fruiting take place throughout the year. The fruits are effectively distributed by birds. Specimens have been seen flowering and fruiting when 1 year old.

DISTRIBUTION & SILVICULTURE. Trema is very widely distributed, being found in parts of the Coastal Scrub and Grassland, throughout the High Forest Zone and in the Savannah-Woodland as far north as Nyankpala (near Tamale). It is a strong light demander throughout its comparatively short life - probably less than 10 years in many cases. It is an invader in clearings, especially those on poorer soils - in this it differs from the more selective Musanga. Trema grows very quickly in open conditions, and a height of 20 ft. and 5 in. G.B.H. in the first year are not unusual. It is often found in groups in clearings where it may be a useful nurse to other tree species. Although a pioneer in Secondary Forest, it disappears when a closed canopy of trees is formed.

SEEDLING. Germination is epigeal. The hypocotyl is short, being ½ in. or less in length. The cotyledons are oblong, about 0.8 in. long and petiolate (0.1 in. long). The first two leaves are simple, opposite and about ½ in. above the cotyledons. The succeeding leaves are alternate and increase in size. The 3rd. leaf is broadly lanceolate, about 1½ in. long and 0.6 in. broad, serrate, acuminate, broadly cuneate or rounded at the base, glabrous, trinerved from the base, with a slender petiole about 0.2 in. long ans with very small stipules. These stipules are shorter than those on the very similar seedling of Chlorophora.

NATURAL REGENERATION. This is prolific in clearings. It does not appear to compete with Musanga, and usually colonies of these two species are separate. In clearings in regeneration plots it has been found that young Trema plants can be uprooted easily by pulling. This ensures that no coppice regrowth takes place.

ARTIFICIAL REGENERATION. This is surprisingly difficult. Although 22 ft. high plants were obtained in 2 years in the Abutia Hills F.R. Nursery, the only other recorded successes are in the Pra-Anum and Bobiri Nurseries. where only 1% germination was obtained; there the plants were 7 ft. 4 in. in 8 months. It is suggested that the seeds require to be passed through the alimentary tract of birds for successful germination.

VERBENACEAE.

Most of the members of this family are trees and shrubs. The leaves are opposite, decussate, exstipulate, the young stem and branchlets are often square in section, the flowers are usually hermaphrodite, zygomorphic and pentamerous, and the fruit is generally a drupe but sometimes a capsule.

In addition to the species described below, mention may be made of Clerodendrum L., a genus of scandent shrubs and lianes, Lanata camara L., an introduced scandent shrub now established in parts of Akwapim and becoming a dangerous weed, and Vitex L., of which there are various species of small trees in the High Forest and Savannah-Woodland. There are also the exotics Gmelina arborea L. and Tectona grandis L., both of which are grown in the Gold Coast as plantation crops.

AVICENNIA L.

Avicennia nitida Jacq.

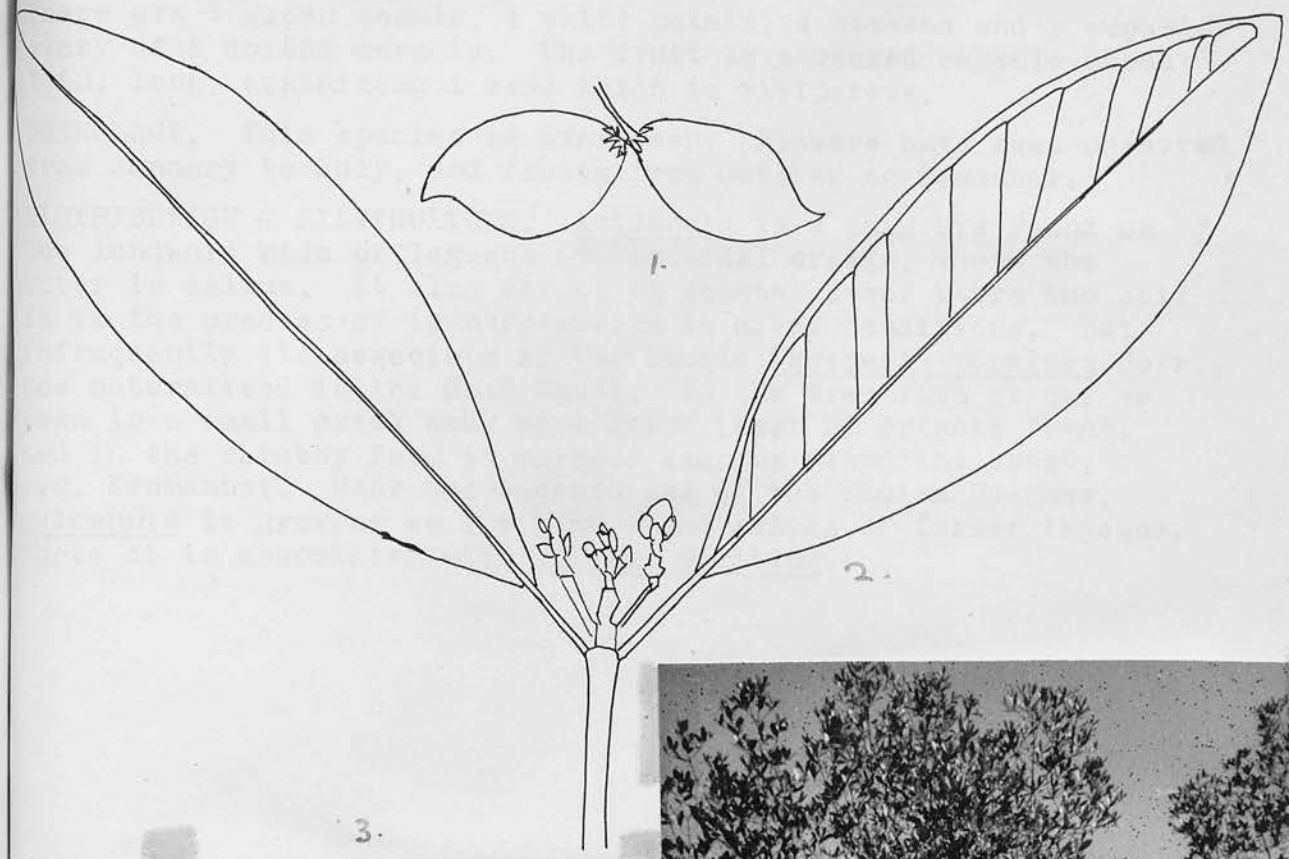
SYNONYM. A. africana P.Beauv.

VERNACULAR NAMES. Amutzi (E). Asokpolo (Ga). Asoporo (F).

The Black Mangrove.

A small mangrove tree from 4 ft. to 25 ft. high, and up to about 3 ft. girth. Although larger specimens are reputed to exist, those seen in the Gold Coast all come within the category of shrub to small tree. Where a bole exists, it may be twisted and branched for its whole length. Pheumatophores are abundant. When it gets above the shrubby stage, stilt roots are formed. The bark is dark grey and rough with small scales. The slash is bright yellow, darkening quickly and hard. The sapwood is white and hard. A good firewood is obtained from the tree. The bark is used for tanning fishing nets, but less so than formerly because of the synthetic preparations available on the market.

BOTANY. The leaves are opposite, decussate and exstipulate. The leaf is simple, oblong-lanceolate, about 4½ in. long and 1½ in broad, entire, acute to obtuse, cuneate, coriaceous, shiny green on the upper side and dull greyish-green below. The midrib is raised below and the nerves are faint and looped, with a submarginal nerve present. The petiole is about ½ in. long and channelled above. The young shoots are almost square in section and puberlous. The inflorescences are terminal and the scented flowers are small, clustered and pedunculate.



3.

4.

Avicennia nitida. 1.Fruits x 1.
2.Flowering shoot. 3 & 4. Trees.

There are 5 green sepals, 4 white petals, 4 stamens and a superior ovary of 2 united carpels. The fruit is a beaked capsule about 1 in. long, containing 1 seed which is viviparous.

PHENOLOGY. This species is evergreen. Flowers have been observed from January to July, and fruits from October to December.

DISTRIBUTION & SILVICULTURE. Avicennia is a mangrove found on the landward side of lagoons and in tidal creeks, where the water is saline. It also occurs in coastal areas where the soil is in the process of transformation to drier conditions. Not infrequently its associate is the exotic Thespesia populnea Corr., now naturalised in the Gold Coast. In the tree form it may be seen in a small creek near West Point (east of Princes Town), and in the shrubby form in various lagoons along the coast, e.g. Kromantsi. Near the eastern end of the Elmina By-pass, Avicennia is growing on dry land - the relics of former lagoons. There it is associated with Cyperus maritima.

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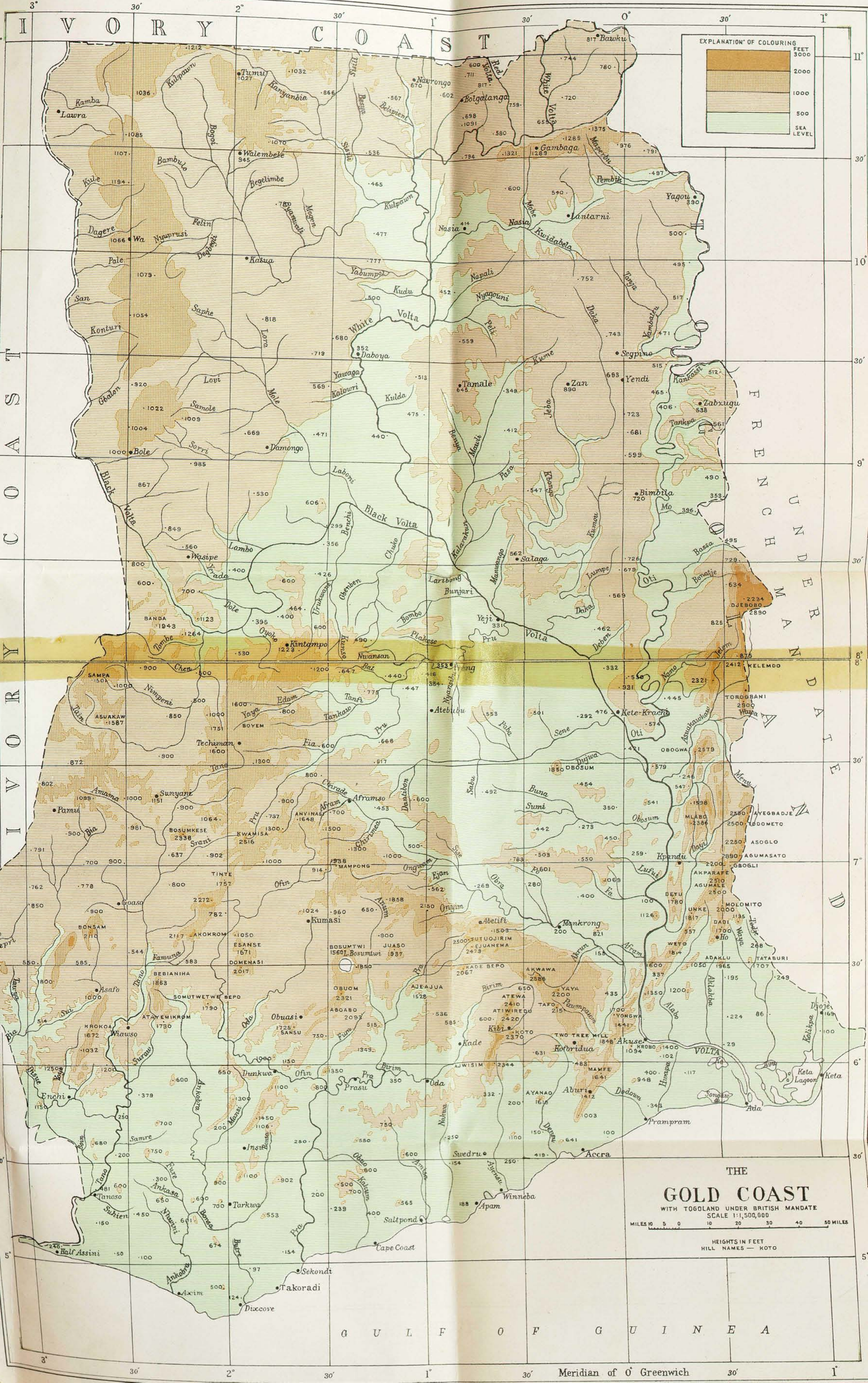
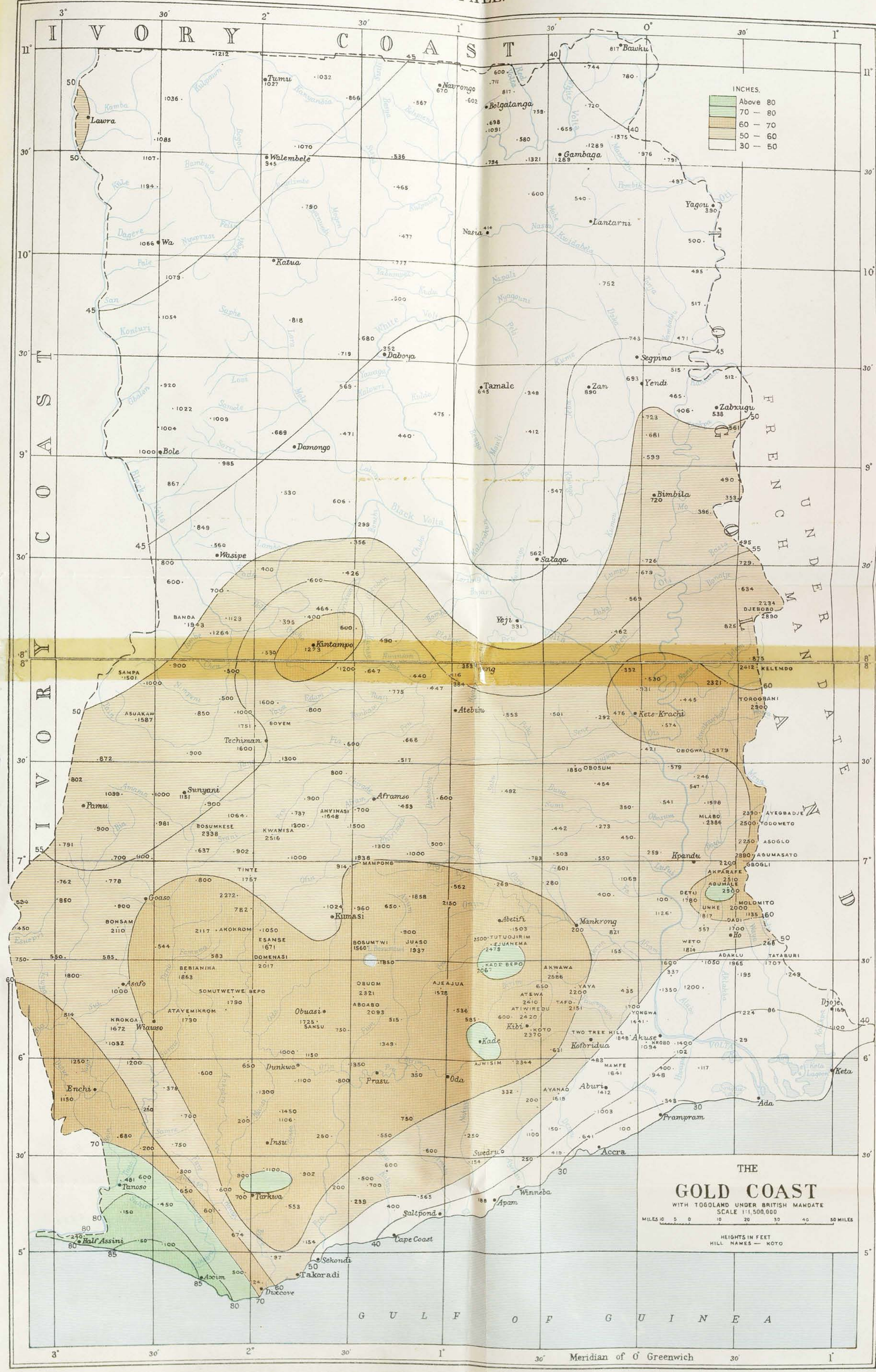
Appendix 1.

PHYSICAL.



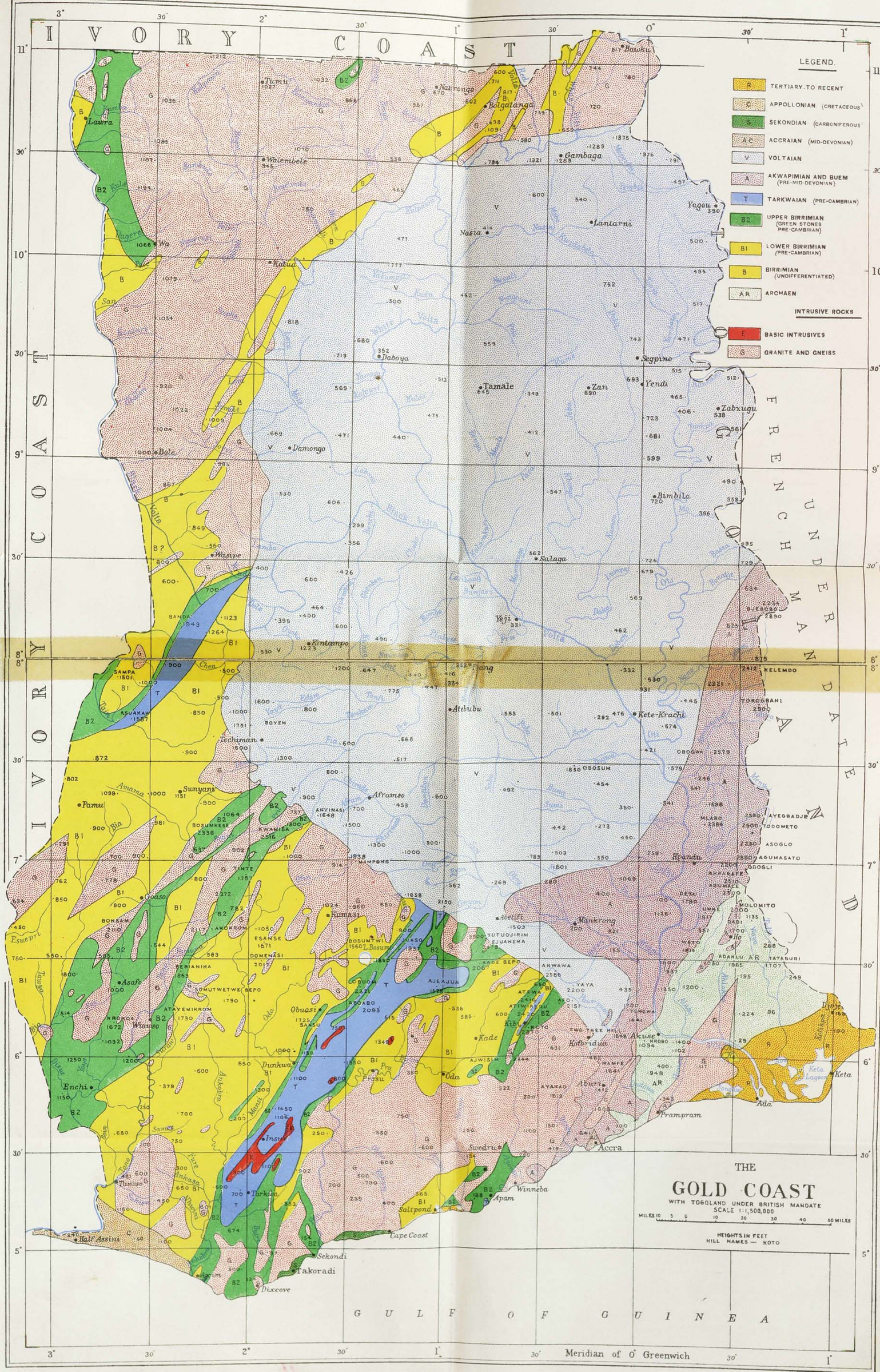
Appendix 2.

RAINFALL.



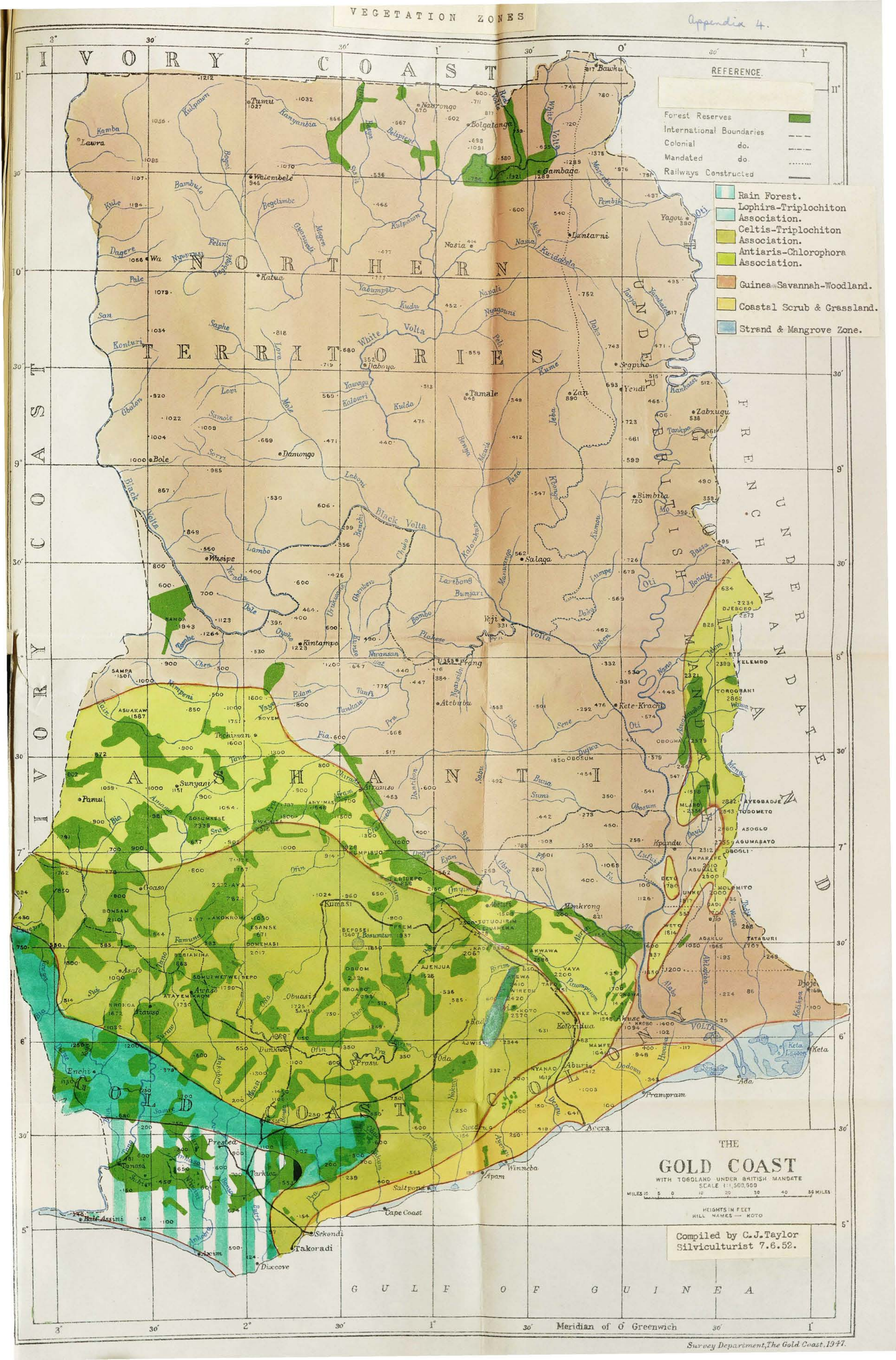
Appendix 3.

GEOLOGICAL



VEGETATION ZONES

Appendix 4.


IVORY COAST
NORTHERN TERRITORIES
ASHANTI
GOLD COAST
TOGOLAND UNDER BRITISH MANDATE
FRENCH MANDATE
GULF OF GUINEA
REFERENCE.
Forest Reserves
International Boundaries
Colonial do.
Mandated do.
Railways Constructed
Rain Forest.
Lophira-Triplochiton Association.
Celtis-Triplochiton Association.
Antiaris-Chlorophora Association.
Guinea Savannah-Woodland.
Coastal Scrub & Grassland.
Strand & Mangrove Zone.
Bawku
Gambaga
Bolgatanga
Tumu
Lawra
Wa
Wiembele
Katua
Jaboya
Segpino
Yendi
Zabzugu
Tamale
Damongo
Bole
Wasipe
Salaga
Bimbila
Yeji
Kintampo
Atebubu
Kete-Krachi
Techiman
Sunyani
Kumasi
Goaso
Dunkwa
Prestea
Tarkwa
Half Assini
Sekondi
Takoradi
Dixcove
Cape Coast
Saltpond
Winneba
Accra
Prampram
Ada
Keta
Lantarni
Nasia
Yagou
Jabe
Nkwanta
Kpandu
Ho
Kpeve
Akuse
Abetifi
Nsuta
Bekwai
Obuasi
Konongo
Oda
Nsawkaw
Enchi
Axim
Asafo
Awaso
Bonsa
Tanoso
Aowin
Sefwi
Wiawso
Bibiani
Juaso
Nkawkaw
Suhum
Koforidua
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Aburi
Dodowa
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Apam
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Densu
Volta
Afram
Oti
Daka
Kulpawn
Sisili
Red Volta
White Volta
Black Volta
Mo
Kulpawn
Kanyanbia
Bagbi
Bambulo
Kulbe
Dagere
Nyanyasi
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Famund
Ankobra
Bia
Sui
Tano
Pra
Ofin
Oda
Birim
Densu
Ayensu
Kakum
Afram
Volta

Appendix 5.

ANKASA RIVER FOREST RESERVE. 5°15' N. & 1°35' W.

Cynometra-Lophira-Tarrietia Association.

120 acres enumerated.

Species	Girth classes in feet.				
	3-5	5-7	7-9	9-11	11+
Allanblackia parviflora	77	11	2	-	-
Alstonei boonei	-	-	-	1	-
Amphimas pterocarpoides	3	3	1	-	-
Aningueria robusta	23	11	5	-	-
Anopyxis ealaensis	2	2	4	6	1
Antiaris africana	-	-	-	1	-
Araliopsis tabouensis	6	3	-	-	-
Berlinia auriculata	3	-	2	-	-
B. grandiflora	16	4	-	1	-
Blighia sapida	13	5	-	-	-
Bombax brevicuspe	8	1	-	-	-
B. buonopozense	1	-	-	-	-
Bridelia grandis	4	6	3	-	-
Canarium schweinfurthii	1	1	1	2	3
Carapa procera	33	-	-	-	-
Cathormion diklagei	-	-	-	1	-
Chlorophora excelsa	1	-	-	-	-
Chrysophyllum sp.	1	2	1	-	-
Cleistopholis patens	4	6	-	-	-
Coelocaryon oxycarpum	14	5	-	-	-
Cola acuminata	28	-	-	-	-
C. maclaudii	56	1	-	-	-
Combretodendron africanum	2	3	-	-	-
Coula edulis	113	53	6	1	-
Craterispermum cerinanthum	42	1	-	-	-
Cynometra ananta	28	12	6	4	-
Daniellia thurifera	44	16	2	5	4
Dialium aubrevillei	23	13	7	6	-
Diospyros sanza-minika	86	3	-	-	-
Distemonanthus benthamianus	3	1	-	-	-
Enantia chlorantha	5	-	-	-	-
Erythrophleum ivorense	3	3	7	3	2
Fagara macrophylla	7	3	3	-	-
Funtumia africana	37	6	-	-	-
Garcinia kola	-	1	-	-	-
Garcinia polyantha	13	-	1	-	-
Guarea cedrata	1	-	-	-	-
Hannoa klaineana	75	22	3	-	-
Holarrhena wulfsbergii	173	25	1	-	-
Khaya ivorensis	1	3	2	3	1
Klainedoxa gabonensis	16	9	11	4	-
Lophira procera	7	8	15	11	5
Lovoa klaineana	-	2	-	-	-
Maba bipindensis	[illegible]	4	-	-	-
Macaranga barteri	1	1	-	-	-
Macrolobium bilineatum	34	17	6	1	-
M. preussii	48	6	1	1	-
M. splendidum	5	2	-	-	-
Mammea africana	47	14	4	1	-
Mimusops heckelii	10	5	-	1	2
Mitragyna ciliata	11	7	6	-	-
Musanga cecropioides	34	11	1	-	-
Myrianthus serratus	2	-	-	-	-
Newtonia insignis	5	2	-	-	-
Ochthocosmus africanus	25	11	-	-	-
Omphalocarpum ahia	2	3	1	-	-
Ongokea gore	2	3	1	2	-
Pachylobus barteri	243	61	2	-	-
Panda oleosa	8	2	-	-	-
Parinari tenuifolia	7	1	3	1	-
Parkia bicolor	18	17	13	6	-
Pausinystalia lane-poolei	5	-	-	-	-
Pentaclethra macrophylla	2	4	2	1	1
Pentadesma butyracea	230	60	11	3	-
Phialodiscus unijugatus	-	1	-	-	-
Picralima nitida	4	-	-	-	-
Piptadenia africana	21	12	12	10	1
Protomegabaria stapfiana	146	15	2	-	-
Pycnanthus angolensis	5	1	1	-	-
Sacoglottis gabonensis	10	9	13	14	16
Sarcocephalus diderrichii (Nauclea)	3	5	10	7	3
S. pobeguinii (Nauclea)	2	4	1	-	-
Scotellia chevalieri	60	3	-	-	-
Scytopetalum tieghemii	306	40	2	-	-
Sterculia elegantiflora	1	-	2	-	-
Strephonema pseudocola	117	54	5	1	-
Strombosia pustulata	58	2	-	-	-
Symphonia gabonensis	7	2	1	-	-
Tarrietia utilis	8	7	2	-	-
Tetrapleura tetraptera	6	4	2	1	-
Tetrorchidium didymostemon	1	-	-	-	-
Trichilia heudelotii	1	-	-	-	-
T. prieuriana	-	1	-	-	-
Trichoscypha arborea	40	2	-	-	-
Tylostemon mannii	35	13	1	-	-
Uapaca heudelotii	24	8	-	-	-
U. paludosa	90	75	20	-	-
Vitex micrantha	27	2	1	-	-
Xylopia quintasii	29	-	-	-	-
X. staudtii	125	1	-	-	-
Totals	2886	737	209	99	39

Appendix 6.

KAKUM FOREST RESERVE. 5°25' N. & 1°20' W.

Lophira-Triplochiton Association.

150 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Albizzia ferruginea	16	2	3	-	4
A.zygia	20	4	2	-	-
Alstonia boonei	44	25	9	7	-
Amphimas pterocarpoides	15	5	4	1	-
Antiaris africana	35	17	10	8	3
Blighia sapida	46	20	10	1	-
Bombax buonozense	25	17	8	5	5
Bosquiea angolensis	44	2	-	-	-
Bussea occidentalis	71	5	-	-	-
Calpocalyx brevibracteactus	15	9	-	-	-
Carapa procera	306	-	-	-	-
Ceiba pentandra	12	13	7	3	10
Celtis adolfi-frederici	22	10	7	3	-
C. soyauxii	506	120	28	2	1
C. zenkeri	128	25	4	-	-
Chlorophora excelsa	18	10	8	5	16
Cistanthera papaverifera	74	32	20	3	-
Cola acuminata	21	-	-	-	-
C. cordifolia	59	57	16	10	-
Combretodendron africanum	197	27	14	9	-
Corynanthe pachyceras	23	-	-	-	-
Diospyros sanza-minika	21	-	-	-	-
Ehretia trachyphylla	105	-	-	-	-
Entandrophragma angolense	81	13	3	6	5
E. cylindricum	11	7	6	4	5
Funtumia africana	82	-	-	-	-
Guarea cedrata	48	15	7	4	-
Hannoa klaineana	29	13	5	1	-
Homalium dolichophyllum	55	6	-	-	-
Hymenostegia afzelii	25	-	-	-	-
Khaya ivorensis	12	9	5	2	1
Lannea welwitschii	40	15	9	2	-
Lophira procera	9	3	8	2	9
Lovoa klaineana	3	-	-	-	-
Macrolobium splendidum	20	4	-	-	-
Mimusops heckelii	2	-	1	-	-
Mitragyna ciliata	8	5	2	1	-
Monodora myristica	161	7	-	-	-
Myrianthus arboreus	111	-	-	-	-
Pachylobus barteri	45	-	-	-	-
Panda oleosa	79	-	-	-	-
Parkia bicolor	58	29	14	8	-
Piptadenia africana	120	43	25	15	18
Pycnanthus angolensis	83	29	14	9	-
Randia genipaeflora	33	-	-	-	-
Ricinodendron africanum	44	22	16	1	-
Sarcocephalus diderrichii (Nauclea)	2	3	4	4	-
Scytopetalum tieghemii	18	6	2	-	-
Sterculia rhinopetala	43	29	12	-	-
Strombosia pustulata	193	7	-	-	-
Tarrietia utilis	14	1	1	-	1
Terminalia ivorensis	2	1	3	6	4
T. superba	11	29	15	7	3
Triplochiton scleroxylon	50	48	31	34	19
Trichilia heudelotii	88	-	-	-	-
T. prieuriana	182	-	-	-	-
Xylia evansii	51	11	1	1	-
	3636	755	334	164	104

Appendix 7.

BOBIRI FOREST RESERVE. 6°10' N. & 1°20' W.

Celtis-Triplochiton Association.

94 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11+
Albizzia ferruginea	3	2	4	3	2
A. gummifera	4	3	1	-	-
A. zygia	12	5	2	3	-
Alstonei boonei	19	7	2	2	2
Amphimas pterocarpoides	6	4	1	2	2
Aningueria robusta	30	12	7	2	3
Anopyxis ealaensis	1	2	-	-	1
Antiaris africana	24	8	5	2	6
Antrocaryon micraster	2	2	1	-	-
Baphia nitida	1	-	-	-	-
B. pubescens	3	-	-	-	-
Blighia sapida	16	5	1	1	1
Bombax buonopozense	2	1	-	1	2
Bosquiea angolensis	54	6	2	1	-
Bussea occidentalis	25	12	4	-	-
Carapa procera	12	-	-	-	-
Ceiba pentandra	1	-	-	1	22
Celtis spp.	305	78	45	19	7
Chlorophora excelsa	7	1	2	1	3
Chrysophyllum spp.	10	3	-	-	-
Cistanthera papaverifera	66	28	6	1	-
Cleistopholis patens	33	8	2	-	-
Cola acuminata	42	3	-	-	-
Cola cordifolia	68	17	11	2	1
Combretodendron africanum	15	12	4	2	1
Cordia platythyrsa	-	4	-	-	2
Corynanthe pachyceras	79	41	9	-	-
Craterispermum cerianthum	1	-	-	-	-
Cylicodiscus gabunensis	25	7	5	4	17
Daniellia similis	3	4	2	-	2
Desplatzia lutea	1	-	-	-	-
Dialium dinklagei	1	-	-	-	-
Dichapetalum flexuosum	2	1	-	-	-
Diospyros monbuttensis	2	-	-	-	-
Distemonanthus benthamianus	6	2	1	1	-
Drypetes vignei	1	-	-	-	-
Entandrophragma angolense	13	5	5	-	5
E. candollei	2	1	-	-	-
E. cylindricum	22	6	9	2	20
E. utile	2	-	2	1	9
Erythrina altissima	3	-	2	-	-
Fagara macrophylla	3	2	1	1	-
Ficus exasperata	9	3	-	-	-
Funtumia elastica	7	1	-	-	-
Guarea cedrata	16	3	-	2	1
Hannoa klaineana	14	-	1	-	-
Holarrhena wulfsbergii	-	1	-	-	-
Holoptelea grandis	2	-	-	1	-
Homalium dolichophyllum	1	-	-	-	-
Hymenostegia afzelii	33	-	-	-	-
Khaya ivorensis	17	5	8	5	20
Lannea welwitschii	31	11	7	2	1
Lecaniodiscus cupanioides	5	-	-	-	-
Lonchocarpus sericeus	3	2	-	-	-
Macaranga barteri	1	-	-	-	-
Macrolobium limba	1	-	-	-	-
Mammea africana	2	2	1	-	-
Mansonia altissima	9	11	8	1	-
Mimusops heckelii	2	2	2	-	2
Morus mesozygia	1	2	-	-	-
Musanga cecropioides	15	3	-	-	-
Myrianthus arboreus	53	3	-	-	-
Omphalocarpum procerum	37	10	7	2	-
Ongokea gore	3	-	1	1	-
Pachypodanthium staudtii	10	1	1	-	-
Panda oleosa	84	12	3	-	-
Parkia bicolor	-	-	1	-	-
Phyllanthus discoideus	4	2	2	-	-
Piptadenia africana	20	3	1	1	8
Pseudospondias microcarpa	1	-	-	-	-
Pterygota macrocarpa	26	32	6	3	3
Pycnanthus angolensis	9	11	7	2	-
Randia genipaeflora	1	1	-	-	-
Rauvolfia vomitora	1	-	-	-	-
Ricinodendron africanum	19	12	11	7	2
Rinorea dentata	3	-	-	-	-
R. oblongifolia	1	-	-	-	-
Sarcocephalus diderrichii (Nauclea)	1	2	-	-	3
Scottellia coriacea	3	-	-	-	-
Spathodea campanulata	1	1	-	-	-
Sterculia elegantiflora	18	7	2	2	-
S. rhinopetala	71	37	13	1	-
S. tragacantha	37	10	-	-	-
Strombosia pustulata	38	4	-	-	-
Tecleopsis sp.	4	-	-	-	-
Terminalia ivorensis	4	7	3	6	3
T. superba	13	6	24	17	10
Tetrapleura tetraptera	8	2	-	-	-
Trichilia heudelotii	30	1	-	-	-
T. lanata	14	4	-	-	-
T. prieuriana	195	32	-	-	-
Triplochiton scleroxylon	74	60	47	28	93
Trymatococcus kamerunianus	13	-	-	-	-
Turraeanthus africana	68	21	5	1	-
Uapaca heudelotii	2	-	-	-	-
Vitex rivularis	16	4	-	-	-
Xylia evansii	25	3	2	4	1
Xylopia quintasii	16	-	-	-	-
Totals	2019	625	299	138	255

Appendix 8.

ONUEM-NYAMIBE SHELTERBELT FOREST RESERVE. 6°5' N. & 1°20 W.

Celtis-Triplochiton Association.

62 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Albizzia ferruginea	3	-	-	-	-
A. gummifera	2	-	-	-	-
A. zygia	10	3	2	-	-
Allanblackia parviflora	28	2	-	-	-
Alstonei boonei	8	2	5	4	2
Amphimas pterocarpoides	8	1	3	3	3
Anopyxis ealaensis	2	-	1	1	-
Antiaris africana	9	5	4	3	6
Antrocaryon micraster	4	1	1	-	-
Baphia nitida	9	-	-	-	-
Blighia sapida	11	7	1	-	-
Bombax buonopozense	14	7	2	4	1
Bosquiea angolensis	15	4	-	-	-
Calpocalyx brevibracteatus	-	1	-	-	-
Canarium schweinfurthii	-	-	-	1	-
Carapa procera	58	-	-	-	-
Ceiba pentandra	7	3	2	2	3
Celtis adolfi-frederici	17	1	-	2	1
C. soyauxii	295	74	29	13	4
Chlorophora excelsa	3	-	1	1	2
Chrysophyllum albidum	6	2	-	6	2
C. perpulchrum	13	6	3	-	-
Cistanthera papaverifera	15	11	9	1	-
Cleistopholis patens	5	2	-	-	-
Cola acuminata	9	-	-	-	-
C. cordifolia	39	6	1	3	2
Combretodendron africanum	42	19	14	3	3
Cordia millenii	-	-	1	-	-
Corynanthe pachyceras	27	-	-	-	-
Coula edulis	4	5	2	-	-
Cylicodiscus gabunensis	19	8	11	11	33
Daniellia similis	14	1	2	-	3
Distemonanthus benthamianus	14	2	3	-	2
Entandrophragma angolense	12	1	1	-	1
E. candollei	4	-	-	-	-
E. cylindricum	7	4	7	6	6
E. utile	2	1	-	-	-
Erythrophleum guineense	-	-	1	-	-
Fagara macrophylla	5	1	1	-	-
Funtumia elastica	11	-	-	-	-
Guarea cedrata	10	10	1	1	1
Hannoa klaineana	9	5	1	1	-
Holarrhena wulfsbergii	3	-	-	-	-
Holoptelea grandis	-	1	-	-	-
Hymenostegia afzelii	5	-	-	-	-
Khaya ivorensis	18	8	3	2	12
Lannea welwitschii	7	4	1	-	-
Lonchocarpus sericeus	4	-	-	-	-
Lovoa klaineana	1	2	1	-	-
Mammea africana	8	5	1	3	-
Mansonia altissima	-	-	1	-	-
Mimusops heckelii	-	-	-	2	4
Monodora myristica	1	-	-	-	-
Morinda lucida	1	-	-	-	-
Musanga cecropioides	12	-	-	-	-
Myrianthus arboreus	5	-	-	-	-
M. serratus	6	-	-	-	-
Omphalocarpum procerum	-	1	-	-	-
Pachylobus barteri	52	6	-	-	-
Panda oleosa	40	10	2	-	-
Parkia bicolor	4	1	1	-	-
Pentaclethra macrophylla	3	-	-	-	-
Phyllanthus discoideus	8	-	-	-	-
Piptadenia africana	19	10	9	8	9
Pseudospondias microcarpa	15	2	-	-	-
Pterygota macrocarpa	6	13	5	2	-
Pycnanthus angolensis	4	2	3	1	-
Ricinodendron africanum	10	1	4	4	1
Sarcocephalus diderrichii (Nauclea)	1	1	-	-	2
Strombosia pustulata	162	15	1	-	-
Sterculia elegantiflora	13	8	6	-	-
S. rhinopetala	41	20	6	-	-
S. tragacantha	5	1	-	-	-
Tetrapleura tetraptera	26	3	2	1	-
Terminalia superba	2	3	10	3	7
Treculia africana	30	2	2	2	1
Trichilia heudelotii	48	8	-	-	-
T. prieuriana	83	10	-	-	-
Triplochiton scleroxylon	5	5	6	6	13
Turraeanthus africana	428	190	45	15	8
Uapaca guineensis	8	-	-	-	-
Vitex fosteri	8	-	-	-	-
Xylia evansii	-	2	2	-	-
Xylopia quintasii	9	-	-	-	-
Totals	1871	529	220	115	132

Appendix 9.

AFRAM HEADWATERS FOREST RESERVE. 7°10' N. & 1°40' W.

Antiaris-Chlorophora Association.

185 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Afrormosia elata	9	3	5	-	-
Afzelia africana	6	3	3	1	1
Albizzia ferruginea	14	7	7	-	3
A. gummifera	4	1	-	-	-
A. zygia	27	18	5	4	3
Alstonei boonei	47	28	17	6	1
Aningueria robusta	51	7	4	2	1
Anopyxis ealaensis	2	-	-	-	-
Antiaris africana	39	26	10	16	10
Antrocaryon micraster	-	-	1	-	-
Blighia sapida	20	8	7	3	-
Bombax buonopozense	1	-	1	-	-
Bosquiea angolensis	192	91	1	-	-
Bussea occidentalis	55	36	1	-	-
Ceiba pentandra	8	2	2	3	3
Celtis adolfi-frederici	78	31	10	3	-
C. soyauxii	342	49	9	-	-
C. zenkeri	297	153	69	12	-
Chlorophora excelsa	11	4	10	9	40
Chrysophyllum africanum	10	3	1	-	-
C. albidum	75	29	7	-	-
C. perpulchrum	275	89	33	5	-
Cistanthera papaverifera	210	106	12	-	-
C. cordifolia	75	50	21	9	-
Combretodendron africanum	15	7	4	1	-
Cordia millenii	7	5	1	1	-
Corynanthe pachyceras	47	-	-	-	-
Cylicodiscus gabunensis	-	4	2	-	3
Distemonanthus benthamianus	4	4	1	-	-
Entandrophragma angolense	12	5	6	2	1
E. candollei	1	-	-	-	-
E. cylindricum	15	12	9	2	2
E. utile	25	4	3	3	10
Guarea cedrata	21	6	-	-	-
Holoptelea grandis	19	12	4	-	-
Hymenostegia afzelii	94	1	-	-	-
Khaya ivorensis	4	2	6	5	11
Lannea welwitschii	14	9	4	-	-
Mammea africana	3	-	-	-	-
Mitragyna stipulosa	3	-	-	-	-
Morus mesozygia	53	19	5	2	-
Myrianthus serratus	5	-	-	-	-
Panda oleosa	15	1	-	-	-
Parkia bicolor	7	4	2	-	-
Piptadenia africana	88	51	54	39	47
Pterygota macrocarpa	10	6	4	3	-
Pycnanthus angolensis	18	7	10	3	-
Ricinodendron africanum	66	28	10	2	-
Sarcocephalus diderrichii (Nauclea)	-	-	1	-	-
Scottellia chevalieri	34	19	2	-	-
Sterculia rhinopetala	139	46	5	-	-
S. tragacantha	37	13	-	-	-
Strombosia pustulata	42	5	-	-	-
Terminalia ivorensis	9	3	9	9	4
T. superba	19	29	48	27	5
Trichilia heudelotii	15	-	-	-	-
T. prieuriana	198	-	-	-	-
Triplochiton scleroxylon	201	180	135	68	51
Others	923	240	121	45	46
Totals	4011	1466	682	285	242

Appendix 10.

NORTHERN SCARP FOREST RESERVE (EAST BLOCK). 6°40' N. & 0°35' W.

Antiaris-Chlorophora Association.

100 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Albizziz ferruginea	4	7	6	8	1
A. gummifera	5	2	-	-	-
A. warneckii	12	3	1	-	-
Aningueria robusta	75	25	7	1	-
Antiaris africana	21	4	10	6	16
Antrocaryon micraster	9	6	4	-	-
Blighia sapida	2	-	-	-	-
Bombax buonopozense	4	4	4	2	2
Bosquiea angolensis	56	3	-	-	-
Canarium schweinfurthii	1	-	-	-	-
Ceiba pentandra	30	14	14	13	8
Celtis adolfi-fredericî	60	27	8	1	-
C. scottellioides	31	-	-	-	-
C. soyauxii	274	69	17	2	-
C. zenkeri	163	78	18	-	-
Chlorophora excelsa	6	4	7	7	18
Cistanthera papaverifera	209	40	10	1	2
Chrysophyllum albidum	4	-	-	-	-
C. perpulchrum	13	10	2	-	-
Cola cordifolia	20	11	13	5	-
Dichapetalum flexuosum	12	-	-	-	-
Distemonanthus benthamianus	6	3	3	1	-
Entandrophragma angolense	5	1	-	-	-
E. candollei	-	-	-	-	1
E. cylindricum	3	2	-	-	1
Erythrophleum guineense	10	10	3	2	-
Erythropsis barteri	8	1	-	-	-
Fagara macrophylla	5	1	-	-	-
Guarea cedrata	2	-	-	-	-
Holoptelea grandis	28	6	3	-	-
Hymenostegia afzelii	236	-	-	-	-
Irvingia gabonensis	5	4	2	-	-
Khaya grandifoliola	5	4	4	4	1
Mansonia altissima	86	32	9	3	-
Morus mesozygia	19	7	1	-	1
Musanga cecropioides	3	-	-	-	-
Newbouldia laevis	58	1	-	-	-
Pachylobus barteri	16	-	-	-	-
Phialocodiscus unijugatus	1	-	-	-	-
Picralima nitida	15	-	-	-	-
Piptadenia africana	18	15	11	9	8
Pterygota macrocarpa	43	34	18	5	-
Ricinodendron africanum	27	20	6	-	-
Sterculia rhinopetala	42	7	2	-	-
S. tragacantha	52	3	-	-	-
Strombosia pustulata	6	-	-	-	-
Talbotiella gentii	117	-	-	-	-
Teclea grandifolia	187	-	-	-	-
Terminalia ivorensis	3	1	-	1	-
T. superba	20	6	12	8	5
Trichilia heudelotii	6	-	-	-	-
T. prieuriana	76	-	-	-	-
Triplochiton scleroxylon	107	46	39	37	20
Totals	2226	511	234	116	84

Appendix II.

ODOMI RIVER FOREST RESERVE. 7°20' N. & 0°28' E.

Antiaris-Chlorophora Association.

43 acres enumerated.

Species	Girth classes in feet. 3-5	5-7	7-9	9-11	11-+
Afzelia africana	5	2	4	-	-
Albizzia ferruginea	4	2	-	-	-
A. gummifera	4	-	-	-	-
A. zygia	5	3	-	-	-
Alstonei boonei	8	3	-	-	-
Anthocleista nobilis	1	-	-	-	-
Antiaris africana	21	23	13	5	3
Baphia nitida	3	-	-	-	-
Bombax buonopozense	6	4	2	2	1
Bosquiea angolensis	12	1	-	-	-
Bridelia micrantha	9	-	-	-	-
Canarium schweinfurthii	-	2	-	-	-
Ceiba pentandra	6	8	8	6	6
Celtis zenkeri	8	-	1	-	-
Chlorophora excelsa	5	8	2	4	3
Chrysophyllum africanum	5	1	-	-	-
Cola cordifolia	35	14	2	-	-
C. togoensis	7	-	-	-	-
Combretodendron africanum	-	-	1	-	-
Dialium guineense	13	-	-	-	-
Erythrophleum guineense	-	1	-	-	-
Ficus spp.	5	-	-	-	-
Funtumia africana	4	-	-	-	-
Holoptelea grandis	3	2	-	-	-
Khaya grandifoliola	7	6	2	-	-
Klainedoxa gracillima	-	1	1	-	-
Lonchocarpus sericeus	1	-	-	-	-
Maesopsis eminii	3	2	-	-	-
Monodora myristica	1	-	-	-	-
Myrianthus serratus	9	1	-	-	-
Pachylobus barteri	22	20	3	-	-
Parinari polyandra	8	3	2	-	-
Piptadenia africana	1	-	-	1	1
Pterygota macrocarpa	2	2	1	-	-
Pycnanthus angolensis	9	9	2	2	-
Ricinodendron africanum	29	8	2	-	-
Spathodea campanulata	6	-	-	-	-
Sterculia tragacantha	26	4	-	-	-
Terminalia superba	8	3	1	-	-
Tetrapleura tetraptera	5	5	-	-	-
Trichilia heudelotii	1	-	-	-	-
T. prieuriana	16	1	-	-	-
Triplochiton scleroxylon	38	11	7	1	1
Totals	389	161	56	21	15

Appendix 12.

GAMBAGA SCARP (EAST) FOREST RESERVE. 10°32' N. & 0°25' W

Guinea Savannah-Woodland.

444 acres enumerated.

Species	Girth classes in feet. 1-3	3-5	5-7	7-9	9-+
Acacia campylacantha	68	12	-	-	-
A. dudgeoni	955	-	-	-	-
A. mellifera	990	44	-	-	-
A. rhemaniana	19	7	1	-	-
Adansonia digitata	2	-	-	-	2
Adina macrocephala	2	-	-	-	-
Afrormosia laxiflora	402	3	1	-	-
Afzelia africana	365	233	37	7	-
Andira inermis	2	-	-	-	-
Anogeissus schimperi	773	331	109	6	2
Anona senegalensis	1	-	-	-	-
Balanites aegyptiaca	4	1	1	-	-
Bombax costatum	210	52	5	-	-
Borassus aethiopum	6	-	-	-	-
Boswellia dalzielii	14	-	-	-	-
Berlinia heudelotiana	3	1	-	-	-
Bridelia micrantha	137	-	-	-	-
Burkea africana	2646	360	2	-	-
Butyrospermum parkii	1633	106	4	-	-
Cassia sieberiana	2	1	-	-	-
Celtis integrifolia	12	5	1	-	-
Cola laurifolia	1	-	-	-	-
Combretum spp.	1009	20	-	-	-
C. sokodense	452	2	-	-	-
Crataeva adansonii	4	2	-	-	-
Crossopteryx febrifuga	943	31	-	-	-
Cussonia nigerica	37	2	-	-	-
Daniellia oliveri	846	68	4	3	-
Detarium senegalense	2275	6	-	-	-
Dichrostachys glomerata	2	-	-	-	-
Diospyros mespiliformis	171	27	2	-	-
Erythrophleum africanum	466	79	3	1	-
Entada sudanica	81	-	-	-	-
Feretia canthioides	13	-	-	-	-
Ficus spp.	82	13	1	-	-
Gardenia spp.	8	-	-	-	-
G. jovis-tonantis	5	-	-	-	-
Grewia spp.	31	1	-	-	-
Gymnosporia senegalensis	83	-	-	-	-
Haemostaphis barteri	157	5	-	-	-
Hannoa undulata	210	23	-	-	-
Heeria insignis	10	-	-	-	-
Hexalobus monopetalus	465	3	-	-	-
Hymenocardia acida	147				
Isoberlinia dalzielii	566	207	12	-	-
I. doka	325	91	6	-	-
Khaya senegalensis	57	20	10	4	3
Lannea sp.	829	111	2	-	-
L. acida	17	4	1	1	-
L. barteri	8	7	5	2	-
Lonchocarpus laxiflorus	60	1	-	-	-
Lophira alata	139	23	-	-	-
Malacantha alnifolia	2	-	-	-	-
M. multinervis	26	12	--	-	-
Maeurea angolensis	2	-	-	-	-
Mitragyna inermis	129	30	-	-	-
Monotes kerstingii	229	4	-	-	-
Oncoba spinosa	3	-	-	-	-
Ostryoderris chevalieri	82	1	-	-	-
Parinari spp.	485	5	-	-	-
Parkia filicoidea	71	19	1	-	-
Piliostigma thonningii	75	1	-	-	-
Prosopis africana	70	27	3	-	-
Pseudocedrela kotschyi	21	1	-	-	-
Pteleopsis suberosa	105	-	-	-	-
Pterocarpus erinaceus	852	95	6	-	-
Sarcocephalus esculentus (syn. of Nauclea latifolia)	7	-	-	-	-
Sclerocarya birrea	43	6	1	-	-
Securidaca longipedunculata	24	-	-	-	-
Sterculia setigera	82	51	8	-	-
Stereospermum kunthianum	139	3	-	-	-
Strychnos spinosa	98	-	-	-	-
S. innocua	95	1	-	-	-
Syzygium guineense	12	1	-	-	-
Tamarindus indica	56	50	3	2	1
Terminalia spp.	1128	20	-	-	-
T. macroptera	10	4	1	-	-
Trichilia emetica	49	-	-	-	-
Vitex chrysocarpa	3	-	-	-	-
V. cuneata	62	3	-	-	-
Ximenia americana	3	-	-	-	-
Totals	21708	2236	231	27	8